The
GEOGRAPHICAL JOURNAL

Vol CI No 4 R.G.S. *April 1943*

COLONIZATION OF JAVANESE IN THE OUTER PROVINCES OF THE NETHERLANDS EAST-INDIES

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Meeting of the Society, 8 March 1943

I DO not know much about this subject from personal experience because my own work in the Netherlands East-Indies never brought me into close contact with Javanese colonization. But we are fortunate in having with us M. Muhlenfeld, whose personal contribution to that great work has been very important in the years during which he was Director of the Department of Internal Affairs at Batavia. As M. Muhlenfeld was prevented by other duties from preparing a lecture on this subject himself, he gave me both his blessing and the assistance of his experience.

To be able to understand the importance of colonization of Javanese in other parts of the Indonesian Archipelago, we should bear in mind that it means the creation of tens of thousands, eventually even hundreds of thousands, of prosperous peasants out of the poorest people in the most overcrowded districts of Java. I considér this to be one of the most beautiful achievements: to prepare the way for large numbers of people to liberate themselves from conditions of stark poverty to which they are born, and thereby to open up for them the prospect of attaining by their own energy a prosperous life for themselves and their families.

Java is in some parts hopelessly overcrowded. While in 1815 this central island of the Indonesian Archipelago had only about five million people, in later years, as a result of stable government and improved hygienic and economic conditions, this number began to increase rapidly. In 1890 there were over twenty-three million inhabitants, nearly five times as many as at the beginning of the same century. And in 1940 this number had increased to over forty-eight million, tenfold the number of 1815. This meant an average density of population of nine hundred per square mile; the yearly increase is as great as six hundred thousand.

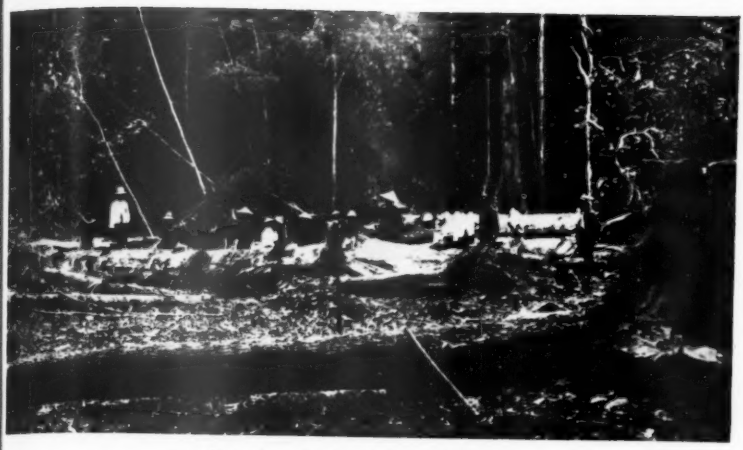
Notwithstanding the fertility of Java's young volcanic soil and the excellent climate, abundant both in rainfall and sunshine, it is not difficult to perceive that such a rapidly increasing density of population in an island, where practi-

cally all available soil up to the very tops of the mountains had been brought under cultivation, must present grave economic problems. In fact, in some districts of Java, mainly in the central part of the island where the overcrowding of population was at its worst, these problems looked as if they were insoluble. The partition of cultivated land among the individual freeholders had gone so far that the size of the individual farms was hardly sufficient for the maintenance of one peasant family; and even then there were thousands of able-bodied peasants who had to go without their own land, and had to eke out a precarious livelihood as agricultural labourers. In some districts large plantations were operating, either on cultivated land rented from native freeholders or on uncultivated stretches of land rented from the Government on long-term leases. In such parts the total sum of money income which the local population could earn, partly as land rent and partly as wages for plantation work, was greater than the sum which could be derived from indigenous cultivation, and therefore this income was able to feed more people. But this could hardly keep an increasingly numerous class of plantation labourers and their dependants alive, for the demand for this labour did not increase at the same rate; in times of depression the demand sometimes rapidly dropped or even temporarily ceased to exist.

Industrialization of the country, as a means of providing a new earning capacity for large numbers of the population, was a method which could not work miracles. Java, like the Netherlands East-Indies in general, principally exports agricultural and mineral raw materials, and is to a great extent dependent on its customers, such as some European countries, America, Japan, or India, who are only willing to pay for their imports by profitable exports of industrial commodities. Therefore industrialization in Java has always had to be controlled carefully.

Neither industrialization nor plantation-economy were able to solve completely the problem of these thousands of Javanese country people, whose numbers were increasing every year, who had no land to call their own, who could not find sufficiently paid work at home, and who seemed therefore doomed to a life of poverty. This spectre had been staring us in the face for a good many years already, and ever since the beginning of this century the idea of organized mass emigration of these Javanese to suitable and thinly populated areas of the Outer Provinces of the Netherlands East-Indies Archipelago had been advocated. This idea had been put into practice too, but up to the year 1930 not with satisfactory results.

This first scheme of Javanese colonization was inaugurated by the Government in 1905 and operated mainly in the Lampong Residency of south Sumatra, where conditions were favourable. This country is close to Java, there is abundance of fertile virgin soil, and there existed little or no possibility of infringement on established land rights of the sparse local population. Under this Government scheme of emigration, the Javanese settlers were given free transport and financial support during the first years in their new surroundings, while experienced civil servants took care of the experiment. However, after some twenty-five years and the expenditure of many millions of guilders, this Javanese settlement in the Lampong Residency numbered but some thirty thousand persons, cultivating only some 25,000 acres.



1. Clearing the jungle, south Sumatra

2. Sastro's plot after two weeks

3. Sastro's plot after three months

4. Sastro's plot after nine months

5. Sastro's rice crop: after one year

6. Sastro's new house: after three years

This result was not at all encouraging, and, on this basis, it would have been far beyond the financial means of the country to carry on a Javanese emigration which could ever have reached the dimensions which we desired. This problem became suddenly acute in 1930, when the world-wide depression of those days hit the Netherlands-Indies, as a producer of raw materials for the world's markets, with its full force and caused widespread unemployment and the closing down of many plantations in Java.

It was at this moment that M. Muhlenfeld in his capacity of Director of the Department of Internal Affairs came into contact with these problems. It was clear that amongst other things something would have to be done about the emigration of Javanese to the Outer Provinces, as one of the means to alleviate the economic misery in large parts of Java, and that a new impetus was needed to the colonization abroad of Javanese peasants.

Now it was known that apart from the colonization organized by the Government, many thousands of other Javanese had settled in the Outer Provinces spontaneously. A good many of them were former plantation labourers who, at the expiration of their contracts, had taken up farming; others had gone abroad entirely on their own initiative and had created a living for themselves. Investigations revealed that these settlers carried on correspondence with their relatives in distant Javanese villages; in these letters questions were put, and answered, about the quality and quantity of available land in the new country abroad, and conditions of life generally. At harvest time there was a shortage of labour in these settlements and the colonists were greatly in need of help during this period. Tales about the new country told by colonists, who returned after many years to their native villages in Java, often made such an impression on their old friends and neighbours that many of these resolved to sell their moderate belongings, leave their homes, and start a new life abroad, at first working for the old-timers, who gave them shelter, food, and part of the harvest for wages, until they had cultivated land of their own.

These observations by M. Muhlenfeld's collaborators together with the experience of M. Rookmaaker, then Resident of the Lampongs, formed the basis of an entirely new system of colonization. In the Lampong Residency, where an important nucleus existed already, there was still room for several times as many colonists, without prejudice to the rights of the local population. An inquiry was therefore made into the number of colonists prepared to receive newcomers with their families, under the traditional conditions just described, thus enabling the newcomers to exist until the ripening of their own first harvest on the land which would be placed at their disposal shortly after their arrival. Several thousand colonists proved to be quite glad of the opportunity to obtain extra help at harvest time in this way.

To enlist new colonists, some of the most energetic of the old settlers were sent to Java to explain, simply and frankly, at popular meetings in the poorer and most densely populated districts, the possibilities that lay before them in Southern Sumatra. The cost of the journey would be borne by the Government. Only peasants with good reputations as workers and still fairly young, healthy, married, and with children would be accepted.

The experiment soon proved a tremendous success; thousands asked to be

allowed to participate. Their own possessions were sold first, in order to hav a little capital to begin with in the new country, and because the smallest an most indispensable belongings were all that they could take with them. I some cases, as when villages had to be evacuated because of volcanic eruption in Java, whole communities, complete with their village administration (con sisting of the village headman, his secretary, the native policeman, and so on undertook the long journey to start a new life abroad. Their reception wa very well organized, every new family being immediately billeted and fed, an indeed no real difficulties arose.

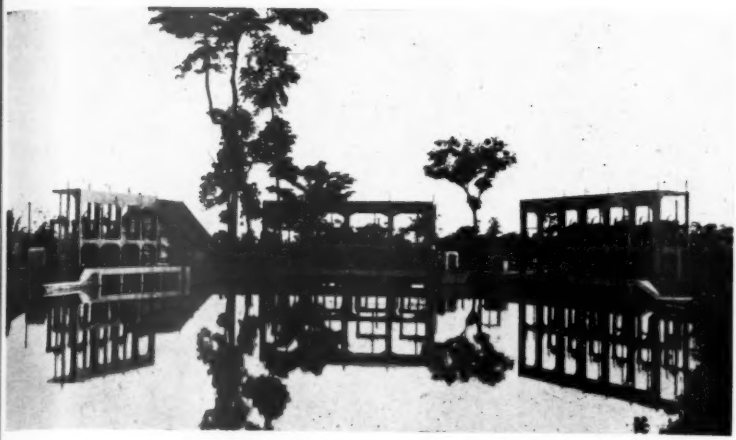
Soon after their arrival, the new families were allotted land which they coul start clearing, after aiding the old colonists to bring in the harvest. The ric they earned as part of their hosts' harvest usually sufficed until the fir harvest from their own ground, but for urgent expenses, as in connection wit buying tools, and building their homes, easy credit, although within well defined limits, was available.

The cost to the Government of this new type of colonization proved t amount to some £3 or £4 per family (merely the cost of transport by the Stat railways of Java and the fare, at a much reduced tariff for large numbers, fo the crossing with the Royal Packet Navigation Company), in contrast with th expenditure of several times that amount in former years, on the old basically unsatisfactory system. Road building, new irrigation works, health, an educational measures, were of course financed by the Government, but fo this outlay a reasonable return was assured from the rapidly growing area o cultivated ground on which taxes could eventually be levied.

Whereas the experiment from 1905 to 1930 had only resulted in the settle ment of thirty thousand colonists in the Lampong Residency and seve thousand in other parts of Sumatra, in 1931–32 there were about ten thousan new colonists under the new system. This number increased rapidly to a yearly average of about thirty-five thousand in 1938, and more than fift thousand in 1940, the majority still going to Sumatra, but a growing per centage to Borneo and Celebes.

Instead of the insignificant numbers of emigrants under the old and costl Government scheme, who were entirely dependent on Government organiza tion and financial support, a steadily increasing flow of Javanese families o the best peasant stock in this way began to populate the empty spaces of th Outer Provinces. And once having gained this momentum, this average o fifty thousand and more yearly, Javanese colonization needed but little en couragement and financially only the smallest possible support from th Government Treasury to increase continually. In fact, thanks to the ne methods in which human nature and individual enterprise had been bett recognized than before, colonization had become a real factor in the proce of relieving Java in order to develop the Outer Provinces. Indirectly, the ne settlements also stimulated the home industries of Java.

But apart from this general economic point of view, there is the individu human side of the process—the change of life for these decent Javanes families, and the new perspective which was opened for them. This is some thing which cannot be expressed in figures and statistics, but we can try to g an adequate impression of its importance by studying the progress of one o



7. Irrigation works at Trimurdjo

8. Tertiary irrigation canals

9. Small village road

10. Village headman's house

11. Metro: house of chief of the district

12. Constructing roads

these many thousands of settlers on his way from poverty to prosperity. Sastro was a Javanese peasant who was registered as No. 1551 in the 1938 group of emigrants.

For the sake of contrast, let us try to imagine Sastro present among a number of poor people at a communal kitchen somewhere in an overcrowded centre of Java. There is little hope for him that he may ever be a landowner, for all the available soil in Java is already cultivated and divided. But he has heard of some mysterious opportunity offered by *Kangdjeng Goubernemen*, the Venerable Government, as it is commonly called, to travel by railway and by steamship to some far away place abroad, where there is plenty of fertile land available for Javanese people such as he, who are capable and willing to work. And therefore one day when the Dutch Controleur (a subaltern in the Civil Service) with his two Javanese assistants comes to his village to explain this proposition, Sastro, together with a good number of his neighbours, thinks he might just as well go up and listen to what this young Tuan and his companions have to tell them. After due consultation with his wife, Sastro decides that there might be something in this scheme, and anyway they cannot lose much by giving it a chance. And so one day he finds himself and his family, together with a lot of his friends from his village, at the quay somewhere in south Sumatra, where they set foot for the first time as immigrants from an old to a new world.

Meanwhile, a lot of preliminary work has been going on at the place of their destination in the interior (Plate 1). Squads of experienced old-timers have been busy on the spot to cut at least the heaviest trees and to clear some of the worst jungle and creepers away; but even then Sastro's allotment does not look much of a place (Plate 2). This is a difficult moment. But, on the other hand, the old-timers have been busy also on other parts of the grounds in erecting temporary houses, in which Sastro and his family are going to stay close to the old settlers.

The next morning after his arrival, the family's luggage is brought by motor bus. Sastro's wife has to take care of that, together with the youngsters, for Sastro himself has to report at the colonization centre, where he is duly registered as a citizen of the new Javanese village which is to grow in this place. After these formalities are over, he is provided with the necessary tools and some other things which he was not able to bring from Java; then he goes to his temporary home and starts work.

Let us now make a jump of some three months and see what Sastro's plot looks like after this period (Plate 3). He has sown his initial crop of cassave while the first of his banana trees is beginning to spread its big leaves. When his own house is about ready, Sastro gets busy sowing his second crop, this time of maize; his banana trees are prospering fairly well where only nine months before there was nothing but dense and steaming jungle (Plate 4).

However all this is only the beginning. For being a self-respecting Javanese of peasant stock, Sastro after all takes a poor view of these initial crops of cassave and maize; the only real thing is the cultivation of rice, the possession of a paddy-field, if possible eventually of irrigated rice terraces or *sawahs*. But this rice cultivation cannot be had without large-scale preparation and without an efficient irrigation system. Fortunately, the Venerable Government

realizes that it is not possible to invite Javanese families to emigrate to Sumatra if you cannot open up a prospect for them that one day they may reap their rice harvest from their own land. In other words, rice cultivation is, and must always be, the foundation of a successful Javanese colonization.

The Government has planned towards this, and built an irrigation scheme on the local river, the Wai Sekampong, with a principal centre at Trimurdjo (Plate 7). A dam or barrage has been built in this river, and originating from there is the principal irrigation canal, which forms the backbone of the whole colonization area under discussion. Near the dam is the centre of engineering works by which the water is distributed in all directions along a number of secondary irrigation canals. These canals eventually divide their water contents in their turn over a system of small tertiary irrigation canals, and these tertiary canals distribute the irrigation water over the paddy-fields of Sastro and his fellow settlers (Plate 8).

After a year Sastro is a rising young farmer with his first crop of rice already harvested (Plate 5). This, to a young Javanese of peasant stock, is life. His children, well fed, are looking on; Sastro himself can afford to wear a palm-beach jacket and a nice batik sarong. But no picture and no smile is able to represent what is going on in his heart, now that he is harvesting his own rice, an agricultural product which since the dim past of the Javanese people has been so closely knit together with their religious and cultural ideas.

It is altogether a completely different situation from that in which we first met Sastro, at the communal feeding centre in Java where he was huddled with so many of his fellow Javanese, poor, and without any prospects in life. Meanwhile, his wife has not been doing so badly either. In the beginning, there was only a temporary market place, to which she could go to sell some of their bananas or other products or to buy the necessary oils and spices for the kitchen. But now that things are beginning to develop this market is extended, and becomes more like the place she was used to at home in Java; she can now get all the simple things she wants for her household. The village in general is doing well; the paths are cleared, the hedges are well kept, and in the gardens various useful trees and shrubs are growing (Plate 9). Of course, the villagers according to Javanese custom have elected a headman (Plate 10).

Now that the whole district is coming under cultivation, and various villages are springing up, a larger territorial and administrative unit, which combines all these villages and their areas, has to be organized. So just as in Java we see the assistant *wedono* or chief of the district making his appearance. In Metro, the capital of the district, his house is built according to the typical Javanese style, with its large square veranda, where the regular conferences with the village headmen take place (Plate 11). There in the evenings the gamelan, the old-fashioned Javanese orchestra, plays; the traditional dances are performed; and the *wayang*, the age-old Javanese shadow-play, is shown. Shortly, with his unerring instinct for business, a Chinese merchant decides to set up a shop, where the well-to-do Javanese farmer can buy anything he wants, from cigarettes to a bicycle.

Roads are cut through the jungle which separates the different colonization centres from each other (Plate 12). Where there are roads there is motor traffic,

and there you will always find the inevitable Royal Dutch Shell, or the Standard Vacuum Company, represented by a gasoline pump and a little store where they sell the oil for the lamps of the settlement. Metro, which in these few years has sprung from the jungle, now even boasts a doctor of its own and a large clinic. There is also the Government bungalow for travelling civil servants of the various services, such as Public Works, Irrigation, Education, and, alas, also the Inspector of Income Tax; for Sastro and his companions, who a few years before were nothing but a mass of paupers, have in the meantime become prosperous owners of 4–5 acres of land, whose public duty it is to contribute their fair share to the public revenue, thereby enabling more of their fellow countrymen to follow in their trail to a better life.

Three years after his coming to south Sumatra Sastro might be found in his orchard before his larger new house, looking over part of his rice crop, which is now of course many times bigger than his first effort (Plate 6). The land, the house, the trees, are all his property. Moreover, he is now even able to employ two assistants for the harvest, newcomers like himself once, people who are eager to earn something while they are waiting for their own first crops to mature. This simple picture of Sastro shows the progress of one out of so many thousands of Javanese from poverty to prosperity.

DISCUSSION

Before the paper the PRESIDENT (The Rt. Hon. Sir GEORGE CLERK) said: In his lecture to the Society in February 1942 Dr. Hart referred briefly to the remarkable work that the Government of the Netherlands-Indies had done in colonizing Sumatra from the overcrowded population of Java. This afternoon Mijnheer Wibo Peekema of the Netherlands Colonial Administration has undertaken to give us an account of this excellent work, which is important as an example that may well be studied by the administrations of other tropical dependencies.

Mijnheer Wibo Peekema then read the paper printed above, and a discussion followed.

The PRESIDENT: I understand that Mijnheer Muhlenfeld is the man to whom the very remarkable progress of the Javanese emigration to Sumatra is due. His work and his initiative we have seen wonderfully illustrated. He is with us now. I wonder if he would say a word or two?

M. A. MUHLENFELD: Mr. Peekema has spoken about the part I took in the scheme of colonization, and gives me more praise than I really deserve, as a very important part of the work was done by my collaborators. In later years, when the work of colonization had outgrown the Department of Internal Affairs and had been taken over by the Department of Economic Affairs there was most important work done in surveying available land in other parts of the archipelago. Since 1935–36 the work has extended very much.

There is among the audience one of my colleagues, the Director of the Department of Economic Affairs, who arrived in England some few weeks ago. He is, I imagine, much more up to date as to the state of affairs. From 1929, when the new system of colonization started and during the five or six years since I left Java, an enormous amount of work has been done under the aegis of the Department of Economic Affairs.

Mr. Peekema told us that one of the essentials of the new scheme was that the new immigrants provided labour during harvest time when there was great need

of additional labourers. In turn, the immigrants were able to get food, an income, and experience by working for those already established, and thus be in a better position to maintain themselves later. In the first four months of the new immigrant's life, at any rate in the years prior to 1936, the main portion of their income came from what they earned by helping those who had crops ready to be gathered. By helping those already over the initial stages the new arrivals laid the foundation of their own later endeavours.

The PRESIDENT: Would Dr. van Hoogstraten add a word as to the latest developments?

Dr. van HOOGSTRATEN: I cannot add much to what Mr. Peekema has told us because he has given us a very remarkable and comprehensive survey of the really great work which has been done in Java. I had the opportunity two years ago of going out to Sumatra on a ship with some of the colonists; altogether about one thousand Javanese were shipped, making the big voyage to the place which they call *tanah sabrang*, meaning "the other side."

I am glad that Mr. Peekema has stressed the human side of the work because in the twenty years I had spent in Java I had never been so moved by any work we did as by the sight of those peasants travelling what to them was a long, long voyage to "the other side"; settling in the virgin forest; and being able in a few years to make a good living for themselves. Often I had been out with my collaborators to the poorest districts of Java and, when back in the office again, we had discussed what we could possibly do in cases where the harvest had been insufficient, we were always faced by the fact that there were half a million people too many in such an area. When you realize how greatly the Javanese are attached to their soil and to their surroundings, only then can you imagine how very difficult it was to get them, by free will and not force, to make what, in their imagination, was a very long and far away trip.

I would like to add one point to what Mr. Peekema said, namely, that the maintenance of really good hygienic conditions in the places where these peasants went to live was most difficult; it is a well-known fact that wherever the virgin forest is opened up there are mosquitoes and other insects which cause diseases. The Dutch Government had a remarkable system by which from every one hundred persons one man was chosen who was responsible for the daily control of the well-being of those one hundred peasants. If he found a child, a woman, or a man ill he had at once to take the individual to a little clinic in the forest for medical examination. There was also a central hospital, in which the more serious cases were treated. It was gratifying to us that we succeeded in maintaining excellent health conditions not only during the later stages but also at first when the peasants lived in what was very nearly primeval forest.

When you study the various stages of the colonization, as I have done, having watched the peasants arrive in Sumatra and seen the dense forest into which they go to live and work, when you see the improved conditions under which they are living after even six months, and noted the great improvement after a few years have passed and, moreover, when you realize that after even two years many of the peasants are able to go back to Java and bring back to Sumatra their relatives —it is all such a contrast to the poverty of the too densely populated districts of Java that I am very proud of our effort and our achievement and especially pleased that we have been able to present to you this afternoon an account of what was done by the Dutch Government of the Netherlands-Indies.

Finally, I wish to pay tribute to two men to whom belongs the special merit of this wonderful work. One was a collaborator of Mijnheer Muhlenfeld's, Mijnheer Maassen; the other is Mijnheer Rookmaaker, then Resident of the

Lampongs. The latter once stood in the midst of an enormous forest and said: "Here on this place we will make a new town of Javanese people, and we will cut out here, to start with, a large place, a village square, where the new town will be and we will call that Metro"—that is, the big city.

The PRESIDENT: I am sure we have all been deeply impressed by what we have seen and heard this afternoon. Incidentally, Dr. Hoogstraten anticipated one of the questions I was going to ask our lecturer when he mentioned what happened when the virgin jungle is opened up, because I know that when that is done there is apt to be let loose a flood of the most virulent diseases of all sorts. But in this instance it is evident that every contingency had all been thought out well beforehand.

What impressed me, both in the lecture and in the remarks of the speakers who have followed, the results of whose work we have been seeing, was the extraordinary modesty by which they attributed all the success, apparently, to the native virtues of Sastro and his fellow Javanese peasants. But the foresight, the care for the future, the care of those entrusted by Providence to their guardianship is a feature in colonial administration of which the speakers and their Government may well be proud. We are fortunate this afternoon to have heard them on this subject; and may I add that we are also fortunate to have heard them in such excellent English. With the same modesty that has been typical of their work in Sumatra they have taken that in their stride. Let us all hope that the foundations which they have so well and truly laid will last through this present upheaval and that when in a not very distant future the day comes when they will be back again in the Netherlands-Indies they will find their Javanese colonists still growing rice in Sumatra and increasing their 4 acres to at least 40.

THE WATER-SUPPLY OF BRITISH SOMALILAND

A. BEEBY THOMPSON

BRITISH SOMALILAND owed its original value almost entirely to its strategic situation at the entrance to the Red Sea. Its coast has no convenient harbour, and the maritime plains are almost unhabitable for part of the year because of the trying humid air and the annual kharif. As an alternative route into Abyssinia Berbera proved very useful to the Italians when the French imposed irritating restrictions on the movement of goods along the railway from Djibouti. Much merchandise passed through Berbera after large sums had been expended on an all-weather motor road via Hargeisa and the frontier post of Tug Wajaleh to Harar. As a site for aerodromes the country now acquires a new importance.

The population, largely nomadic, of about three hundred and fifty thousand is mainly pastoral, for only in a few districts is dry farming practised. Cultivation is very precarious owing to the vagaries of rainfall, to the ravages of locusts, ants, and other insect pests, wild animals and birds, and to the uncontrolled wanderings of domestic herds. Irrigation is practised only in the valleys of a few watercourses where water can be raised by hand. The sale or barter of camels, oxen, sheep, and goats giving meat, milk, and skins, provides the people's frugal needs; Somali goat skins make high-class kid for gloves.

After a season of low rainfall or the late appearance of the monsoon almost famine conditions prevail and the scenes around the few perennial water centres are extremely distressing. For miles around the wells every edible particle has been devoured and the surface has been converted into a dust bowl by the incessant movement of thousands of animals. Reduced to skeletons by starvation, the emaciated creatures, covered with sores and moving in a cloud of dust become an easy prey to the hyenas, jackals, and even carnivorous birds, while flies in swarms perpetually worry them. Vultures and other carrion birds follow the herds to pounce on any beast that falls. The country is already overpopulated and overgrazed, and unless the destruction of trees is checked and the number and distribution of domestic animals controlled, desert conditions must eventually persist.

Rainfall in British Somaliland, although monsoonal, is too inadequate and capricious to support a healthy vegetation. The wet season breaks in April-May with spasmodic showers or violent, but very local, thunderstorms, and in a few days the favoured districts are transformed from arid wastes with withered scrub to green, grassy plains with leafy shrubs. Rain may fall fitfully until December but usually December to April are rainless months. The gregarious thorn (acacia) sprouts some time ahead of the rains, and a single shower develops a rich foliage and blossom buds. Falls of rain are observed from afar by anxious pastoralists, and the nomadic herdsmen with their emaciated animals trek laboriously, but hopefully, towards those regions. Towards the end of the dry season, especially when the rain is delayed, practically no feed remains within range of watering centres, and the people are driven to uprooting plants with bulbous roots and mutilating or felling trees for the digestible fibre in their branches, thereby increasing

GULF OF ADEN
BRITISH SOMALILAND
Djibouti
Zeila
Berbera
Bender Cassim
Erigavo
El Ayuma
Hudin
Hadin
Callis
Ogal Valley
Dubar
Bihendula
Sheikh
Burao
Tug Der Adad
Gorsonia
El Dab
Ainabo
Wadamago
Kirit
Bohotleh
Damot
Eik
Hargeisa
Sillil
Barano
Jijiga
Miles
Land above 1000 metres
Roads
44°
46°
48°
10°
8°

the aridity of the country. Within a period of twenty years I have noticed a marked diminution of trees, due almost entirely to this deplorable but, from the native point of view, excusable practice of cutting down trees for animal feed in times of stress.

Descending on a surface baked hard by prolonged heat, rain does not readily soak into the ground, but forms pools in low spots or runs on the surface as a thin sheet until drainage channels are reached. If narrow these channels become torrents in a very short time, and travellers caught by storms must squat on the banks of a flooded *tug* until the flood has subsided. Where the land slopes steeply most of the water is lost, and the conditions are thus extremely unfavourable for the replenishment of sub-soil supplies. So rapid is the run-off in river beds that the valley alluvium is often unmoistened a few inches below the surface after a flood of several hours' duration.

These periodical flushes in *tug* beds tail off into sluggish flows of mud which not only coats the surface with an insulating layer, but is carried into the interstices of gravel and sands, making their permeability very low. For this reason shafts or bores sunk into the thick alluvial deposits of many deeply eroded watercourses give very meagre yields, except at the few places where the coarser detritus has escaped plugging by infiltration of mud, or petrification by carbonate of lime. Many river beds draining limestone regions have their pebbles cemented into conglomerates which unless split by differential settlement yield little or no water.

In British Somaliland scores of shafts, boreholes, and drive tube (Abyssinian) wells have in recent years under skilled direction been carried down in *tug* beds and have for the most part given disappointing though decidedly useful yields. Even where coarse, open, free-yielding sands or gravels have been penetrated, good initial outputs have not been long sustained, because of the small sizes of the individual lenticles, and lack of free communication with others. Sections in shafts exhibit a succession of inter-bedded, overlapping lenses of sandy-clays, fine and coarse-grained sands and gravels, embedded in a clay matrix of low permeability, if high porosity.

Towards the end of the wet season there is a general rise of the water-table of most *tug* beds, although the time-lag is often large. At Hargeisa and Burao dozens of shafts have been excavated in the beds of the *tugs*, alongside which the stations have been built, and although they have never failed to yield some water the whole year, the influx declines with the advance of the dry season until long waits must be enforced to permit sufficient water to accumulate. Thirsty, impatient, restless animals have often to wait an unconscionable time for water at the wells which are worked day and night.

The main watershed of British Somaliland follows an irregular course in general alignment with the coast, but more distant (60 miles) from the sea in the west than in the east (16 miles). A precipitous escarpment commonly marks the northern edge of the mountain range, but southwards the land slopes gently as a plateau into Abyssinia and what was formerly Italian Somaliland. Rainfall is highest on the most elevated parts of the mountain chain which reach an altitude of 3000–6000 feet. At the hill-station of Sheikh it varies from 17 to 27 inches a year; at Buramo 15 to 26; at Hargeisa 12 to 15; but at Berbera and Zeila on the coast it ranges between 0·5 and

8 inches a year. Such a low rainfall in a tropical country, even if there were no losses by evaporation or plant transfusion, could be completely absorbed by a few feet of porous soil. Between the escarpment or the flanking foothills and the sea, broad fans of coarse detritus have been deposited, and into these porous formations most of the streams and drainage channels discharge their waters, which spread and dissipate in their descent to sea-level dissolving deleterious salts.

Archean crystalline rocks predominate on the range to the west, but east of a line running southwards from Berbera sedimentary rocks constitute the bulk of the strata exposed. They are mainly limestones and sandstones of Tertiary and Cretaceous age with occasional developments of Jurassic rocks.

There are very few perennial streams in the country, although a number of watercourses expose strips of running water at intervals where their sub-surface movement is impeded. A few fairly large springs issue from the foothills south of the scarp, but most of the escarpment drainage on the north filters away unseen and unused to the sea. The springs at Dubur that give Berbera its water are thermal and heavily mineralized. That of Bihendula issuing from Jurassic rocks is cool and pleasant to drink. South of the escarpment all except flood waters appear to travel underground after a descent to undetermined depths. Trial bores have been carried deep into the thick diluvium and Eocene limestones on the high plateau, in the vain hope of penetrating some fissure system or permeable band, but the results confirmed the original suspicion that such water as enters sinks to great depths and drains away to some point low on the scarp or far inland.

That water circulates in the limestones was strikingly demonstrated by a "breathing" well at Eik where a fissure was struck at 334 feet. There was a blast of high-pressure air which lasted for some hours, followed by suction for about the same time, due to the surging of water during the process of re-establishing pressure equilibrium. Operations were suspended when it became apparent that water under a sub-artesian (pressure) head would not be struck; to raise water beyond about 200 feet is not economic.

Although there is evidence of gentle flexuring, the strata on the plateau dip regionally southwards at a consistently low angle closely conforming with the slope; but in the more disturbed region near the scarp, the rocks are split into blocks by strike- and dip-faults showing little evidence of folding. A red earth covers broad expanses of upland plains, and drilling has shown an immense thickness of argillaceous diluvium almost impervious to water, so that little or no local rainfall can possibly reach the underlying limestones.

Almost the whole of the south-eastern plateau of British Somaliland is overlaid by limestones or anhydrite-gypsum of Eocene age. Sometimes the sedimentaries underlie a veneer of red earthy clay or black cotton-soils, but for hundreds of miles anhydrite-gypsum beds are never out of sight for long. The gypsum is evenly banded with well-marked depositional planes that apparently follow the inflections of the formations on which it reposes. It is found at all altitudes up to 6000 feet, occasionally as an alabaster that splits into large slabs like paving-stones when quarried. In places it forms domes like great blisters, or oval depressions in which the overlying limestones participate, for the gypsum changes in bulk on re-crystallizing into allotropic

forms. Belts of disturbance and zones of disruption may extend for hundreds of yards, with their longest dimension generally north-east to south-west. The disturbed areas are commonly marked by fissures, crevices, or collapsed surfaces towards which land drainage has been deflected during rains to escape down swallow holes. That these were something more than curious spectacles to the past inhabitants is shown by the occasional near-by presence of ancient ruins or graveyards of undetermined age; and water would seem to be the only likely attraction to settlers where it must always have been scarce.

Between Kirit and Erigavo there are many belts of disturbed gypsum where scores of swallow holes admit surface run-off from neighbouring bare areas of gypsum or limestone. Many of the crush-zones with their swallow holes are marked by a solitary and often large fig tree with a wealth of foliage; the only landmark for miles around. The straggling roots grip the loosened rock on the sides of crevices like the arms of a giant octopus, supporting cavities which would otherwise collapse. These trees must owe their size to moisture from a source far below the surface.

Some of the swallow holes are mere cracks only visible on close approach; others occur in groups scattered about a deeply eroded gulley with no other obvious outlet than these vents. Sometimes a quarry-like depression, perhaps 20 feet or more deep, and some acres in extent, marks these localities, and no other explanation than local settlement of beds seems feasible.

Another feature is the general absence of sump holes in low country, and their appearance on the sides or tops of ridges substantially above the plain level suggests that they have originated along the crests of gentle flexures caused either by orogenic movements or differential flowage. The frequent presence of selenite crystals in the neighbourhood of disturbances supports this view. Some of the disrupted areas are so large and marked by such a confusion of fallen blocks that great caverns must have formed before collapse took place; but even now large caves can be seen with roofs supported by thick entwined roots. Few were explored far, on account of accumulated debris and the dangers from snakes and animals which use them as lairs. These caverns are never deep, and some, above which there is a rank growth of shrubs and figs, are very beautiful because the blanched roots simulate the stalactites and stalagmites of limestone caves.

Whatever their origin, there can be no disputing the value of these sumps and swallow holes as sources of supply where water is extremely scarce, for gypsum wells yield some of the largest and most permanent supplies of water in the Colony. At Wadamago, 11 miles east of Kirit, immense quantities of water are obtained at shallow depth from excavations sheltered by giant banyans, beneath which enormous numbers of animals with their shepherds water and rest in comfort. At Gosawein, 4 miles south of the Erigavo road, and 35 miles from Ainabo, sufficient water collects in a depression (*balleh*) after rain to last for about forty-five days if no further rain falls. A large, almost circular, shallow basin appears to have resulted from a general sagging of the beds which have been rendered watertight by puddling with clay, and perhaps organic matter, in much the same way that dew ponds have been formed on the chalk downs of England. To one side of this depression is a strip of disturbed and broken country that includes several swallow holes with col-

Divide near Kasai, 5500 feet

Burao, tug during dry season

El Afweina, lake formed during wet season

Somalis drawing water from 100 foot well at Burao

Great banyan over water-hole at El Dab

Ainabo well, typical native gypsum well

lapsed sides. One roughly hewn shaft sunk in gypsum heavily veined with selenite is reputed to have given water in the past although at present dry and half filled with debris. The most prolific and striking of all water holes in the Colony is at El Afweina, 43 miles from Adad on the Erigavo road. Here a lake many acres in extent forms in the rainy season in a gypsum depression. This seem to be a case where the dry-season water-table closely corresponds with the ground level, but in the rains the water rises and overflows into a basin until a rest point is attained through some subterranean spillway being reached. Tens of thousands of animals have, it is alleged, been watered here daily, and it was one of the places occupied by the Mad Mullah's forces when engaged in ravaging the country.

Ainabo and El Dab are examples of gypsum depressions which never flood but yield immense volumes of water at shallow depth. At the former place a large single excavation serves all comers, and chains of Somalis with precarious footholds on the sides hurl filled skins from one to another until the surface is reached. At El Dab the arrangements are better for a number of wells are used over a wider area, but here the water is not so deep and the lifting is less arduous. During the dry season the water abstracted daily at each is not less than 100,000 gallons. At both places large swallow holes receive the run-off of many acres of almost bare but badly fouled land.

That the gypsum wells are mainly fed by swallow holes is shown by the accumulations of debris commonly found in and around their mouths or clinging to rootlets near by. Leaves, straw, twigs, and even branches half choke the entrances, and people say that the underground rush of water is distinctly audible when water enters. At other holes the water is alleged to filter away slowly and hours may be taken for it to drain from the depressions. Obviously the swallow holes are connected with an intricate system of solution channels, some of which become at times partially or totally choked by silt and debris washed from the neighbouring catchment. The subterranean circulation in the gypsum is superficial for the thickness of the gypsum series probably does not exceed 250 feet anywhere, and is often much less.

Little or nothing is known about what happens in the wet season, as cross-country journeys by Europeans are virtually suspended. Only in the Erigavo district is there evidence of springs within the gypsum belt. A conical mound of yellowish mud contrasting strangely with the surrounding red earth had all the appearance of a mud volcano such as is found in oilfields, but instead of a crater at its centre, there appeared the burrow of some wild animal. Subsequently other hillocks were discovered, and water was found flowing from the summit of one such conical mound from which it was conducted to a near-by garden for irrigation. Here was positive evidence of artesian conditions on the edge of the Erigavo basin. None of the inhabitants could throw any light upon the seasonal behaviour of the inactive cones, but the travertine character of the material suggests light discharges rapidly evaporating and depositing dissolved salts.

All waters from gypsum wells are very hard, many bitter to taste. Some are foul smelling and inky; many are pleasantly potable. The permanent hardness is attributable to sulphates, the temporary to carbonate, and the odour and colour are mainly due to sulphuretted hydrogen and organic impurities.

At all important well centres the surrounding land is badly polluted by animal and human excreta, much of which is swept into the swallow holes when the rains break. Many of the main vents were found choked with animal dung and vegetable debris mingled with other filth washed off the catchment; and some swallow holes close to wells in general use were found to be used as receptacles for refuse as well as public latrines. The effect of organic matter on gypsum is shown by the black patches marking the site of animal corrals.

Similar gypsum waters occur in the Gheil Ba Wazir district of the Eastern Aden Protectorate 40 km. north-east of Mukalla, where thick gypsum beds occur distant from the escarpment marking the edge of the plateau. Two large pools of clear water show where the roofs of gypsum caverns have collapsed; the inhabitants have driven galleries to conduct the water to land at lower levels. These galleries are of the "chain-of-wells" type so frequent in the Near East; the series of wells being used for ventilation and removing the excavated material during construction, as well as for cleaning at later periods. The tunnels were made sufficiently low to draw off about 1,000,000 gallons a day from each pool, and this was employed in irrigating plantations of tobacco, grain, dates, fruit, and vegetables.

Notwithstanding the extreme difficulty of developing sub-soil water supplies in Somaliland, much has been done to alleviate the trying conditions suffered by the indigenous population as well as by those civil and military officers called upon to administer and protect the colony. Prior to the Italian invasion piped services of pumped water had been installed at Burao, Hargeisa, Sheikh, Buramo, and Zeila; and at Tug Wajaleh and Sillil water raised by windmills supplies the needs of travellers and of large numbers of animals. From far afield Somali women journeyed to these latter centres to procure water for their domestic uses. Owing to the difficulty of supplying field parties in remote regions, power drilling has proved costly and slow, but shaft sinking on modern lines under the direction of a skilled artizan has proved a sound innovation.

More ground-water could be tapped in some parts, but unless well-spaced such centres become a menace from the congestion and overgrazing they stimulate. Elsewhere the only feasible method is to impound flood waters in the wet season. But the conservation of muddy storm waters is not cheap or easy as dams in river courses silt up very soon and evaporation is of the order of 12 feet a year. Only in a few places is there sufficient sweet ground-water for irrigation. Spring waters irrigate small gardens in a mountain valley near Erigavo, and vegetables are grown at Hargeisa, Sheikh, Burao, and near Zeila.

El Dab: concrete well made by government with Cumerland well-sinker

Pumped water from Ainabo well

Women waiting for water from Sillil windmill

Yale from the Ngerenyi Rest House

Yale, north-west Taita hills, from the S.S.E.

Looking south down fault-valley of the Bura from below Yale

Yale from the south-east

Yale from the Ngerenyi Rest House

Looking south down fault-valley of the Bura from below Yale

Yale from the south-east

A

A NOTE ON THE TAITA HILLS, KENYA COLONY

JOHN PARKINSON

FOR nearly seventeen months in 1940–41, the writer made extensive traverses across that part of Kenya lying east of Kilima Njaro and north of the Voi–Taveta branch railway. The water supply of the region is of much economic importance because of the rapid desiccation, which has now reached a stage recalling the semi-desert of the Northern Frontier Province of Kenya (*Geogr. J.* 94 (1939) 162).

The central part of the district is drained by the Tsavo river, fed by tributaries rising on the slopes of Kilima Njaro and by the Mzima, a stream of some importance flowing from the north over the lavas south of the Chyulu hills and emptying into the Tsavo some 35 miles west of Tsavo Bridge. This together with the small but valuable streams flowing from the southern slopes of the Taita hills, N.W.–W.N.W. of Voi, are the sole rivers of the district. The Taita hills, described by Joseph Thomson in 1884 as "strikingly suggestive of an archipelago of islands rising with great abruptness from a greyish-green sea," are the divide between the Voi river and the channels draining the hills on the north to the Tsavo. These hills are a geographical entity distinguished by their steep almost precipitous valleys, culminating in a series of picturesque peaks reaching a height of 7000 feet. They form a delightful exception to the depressing country around, for the rainfall, taken over a period of more than twenty years, averages about 50 inches; Voi, about 2000 feet, has some 21·5 inches, and Tsavo has 16 inches.

With the exception of the fertile Taita hills and the neighbourhood of the Voi–Taveta railway the country is now uninhabited and all but waterless, a desolate expanse of thorn-scrub and scattered flat-topped acacias. No map of the whole district which can be considered accurate to within a mile is available.

The tributaries entering the right or southern bank of the Tsavo are only freshets of little value. They are rarely contained between high banks, but generally occupy broad sandy channels in the red soil, mere grooves on the surface like the *lak* or *lugga* of the Northern Frontier Province. Water holes, small and precarious, occasionally brackish, are found at rare intervals, and provide a meagre supply for the abundant animal life.

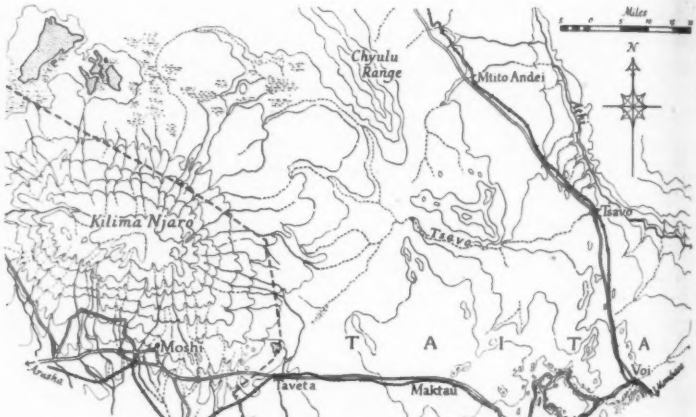
Doubtless, the greater part of the southern slopes and the flatter ground south of the railway are water-bearing and one may surely infer the same, though to a lesser extent, for the land lying beyond the northern slopes and along the flanks to the east and west. Three or four hundred square miles of water-bearing ground to be reached easily by shallow drilling can be taken as assured, and an asset of great value.

The Department of Public Works enabled the writer to examine the logs of thirteen wells, all except three drilled in crystalline rocks. The deepest was 400 feet, the shallowest 100; the average depth was 223 feet, and the average yield 42,000 gallons in the twenty-four hours.

The somewhat tumbled topography of the Taita hills is intimately related to the geological structure. The rocks of the range are essentially the same as

those of the Tsavo basin: gneisses, schists, and hybrid rocks called migmatites, belonging to the oldest subdivision of the geological sequence known in Africa, the Lower Basement Complex of the Tanganyika Survey. Hard, erosion-resisting gneisses, forming the conspicuous ridges and peaks characteristic of the scenery, alternate irregularly with sandy beds which have been formed by the decomposition in situ of the softer members of the same series, producing buff and terra-cotta coloured soils, sufficiently compact to stand in a vertical face, but still clearly retaining the structure and texture of the originals.

This rather unusual condition is due to the selective action of permeating fluids and liquid material derived from a mass of solidifying magma of granitic composition. The rocks subjected to this slow soaking under conditions of high temperature and pressure, were for the most part of sedimentary origin, principally felspathic grits along the Tsavo valley, but characteristically argillaceous in the Taita hills. These allowed the ingress of agents of metamorphism in varying degree with consequent variable capacity in resisting erosion when, long after, they solidified and finally were exposed at the surface of the ground. Thus arose the differential weathering which has produced the wild scenery of the hills, distinguishing them from other parts of Kenya, as the writer knows that colony.



WAVE-TROUGH EXPERIMENTS ON BEACH PROFILES

MISS MARJORIE M. SWEETING

Meeting of the Society, 5 April 1943

A CONNECTION between wave frequency and beach configuration was first recognized by Palmer in 1834,[1] and subsequently by later writers. It was observed that high frequency waves were usually associated with destructive action and consequent combing down of the beach. W. V. Lewis,[2] in 1931, distinguished between constructive and destructive waves and showed that they had very different effects upon a beach profile (Fig. 1). He observed that destructive waves were those of high frequency "resulting in a more or less continuous seaward movement of the water in contact with the beach, thus causing down-combing" and that material was removed by such waves to a lower level on the beach. Constructive waves, on the other hand, were those of lower frequency, and "at all stages of the tide a small

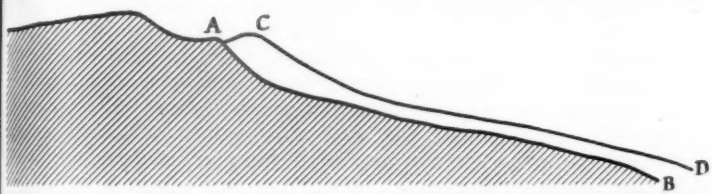


Fig. 1. Beach profile resulting from destructive (AB) and constructive (CD) waves

ridge was present at the landward limit of the swash indicating the continuous return of shingle to the beach."

Though these two distinct types of waves may play upon an ordinary beach, both they and the beach profiles to which they give rise are somewhat difficult to differentiate under natural conditions. Therefore some experiments were conducted in the Wave Trough of the Physical Geography Laboratory of the Cambridge Geography Department to see how far the natural conditions could be imitated and whether the results obtained would throw any light upon the processes at work on an actual shoreline. A description of the Laboratory and of the Wave Trough is given by Professor Debenham in *Geogr. J.* 100 (1942) 223.

Previous work on beach profiles by Colonel Bagnold[3] showed that the mature profile, resulting from a train of waves, consisted essentially of three well-defined zones: an upper beach and a lower beach, separated by a convex step (Fig. 2). Bagnold's experiments were carried out with beaches of loose sand and shingle upon which "the waves themselves were allowed

[1] H. R. Palmer, "Observations on the motion of shingle beaches." *Phil. Trans.*, 1834.
[2] W. V. Lewis, "The effect of wave incidence on the configuration of a shingle beach." *Geogr. J.* 78 (1931) 129.
[3] R. A. Bagnold, "Beach formation by waves; some model experiments in a wave tank." *Journ. Inst. Civ. Eng.*, 1940–41.

to fashion their own beach"; they demonstrated the importance of percolation in the moulding of a beach and in the formation of beach ripples.

In our experiments waves of differing frequency were allowed to play upon a simple beach profile which was initially in every case a uniform slope, but with measured differences in degree of slope and in size of beach material. The longer waves had a length of 2·25 metres and a period of 1·6 seconds, while those of a higher frequency were 1·65 metres long with a period of

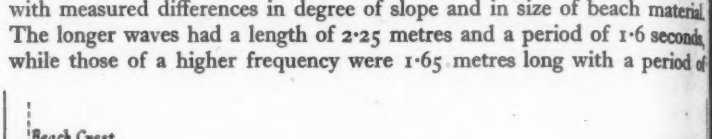


Fig. 2. Three main beach zones of a mature beach profile

1·2 seconds and a much smaller amplitude. In almost every experiment the mature profile showed the development of the three main zones recorded by Bagnold; a state of equilibrium was set up and "just as much material returned as was driven up." The three zones varied considerably in form however with differing wave frequencies, and in some cases the lower beach zone was almost entirely absent.

Sandy beach and low frequency (long) waves

With a relatively steep initial beach slope (16°), changes in the profile were clearly visible after only twenty waves; a mature profile was soon obtained,

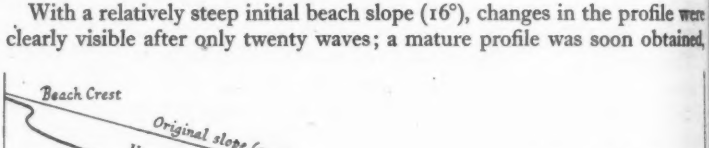


Fig. 3. Beach profile obtained with long waves

after which the beach remained relatively unaltered. This profile of equilibrium showed a marked differentiation into three parts. The upper beach zone (Fig. 3) was formed by a slightly concave slope (maximum 13°) resulting from erosion above water-level and the building-up of a bench below; a nick in the original straight profile occurred at the head of this slope, while its seaward termination was marked by the convex step. The concave slope of this upper beach flattened out somewhat as the experiment continued; the maximum angle of the terminating step remained at about 34–35° and the

preservation of such a steep angle appeared to be due to an upward eddy current. Below the step was a greatly extended lower beach, which showed an interesting development of ripples.

The ripples were of the oscillatory type described by Bagnold, as obtained with a large value of the ratio R (wave amplitude/diameter of particles). The floor of the trough showed a general outward drift and sorting of material, and the ripple-form itself slowly advanced. The individual particles were carried backwards and forwards over the ripple crest with each wave. The size of the ripples did not entirely depend upon distance from the beach step, and there was differential movement and deposition along the floor of the trough. This appeared related to a reflected wave causing a secondary break before the actual break on the beach. As was expected the ripples were closer together when they were small and were nearer the bottom of the trough. A correlation existed between the length of the ripples and the heights of their crests above the bottom of the trough (or an inverse correlation between length of ripple and depth of water). The coefficient of correlation was found to be 0·95. This seemed to show that the wave length of the ripples was related to the amplitude of the oscillations of the water. As the amplitude fell off with depth, so did the size of the ripples.

The waves caused some sorting of material, though it was difficult to see whether any correlation existed between size of ripples and grain size. Sieving the beach material at the beginning and at the end of the experiment showed that the very finest material was carried farthest from the beach and deposited in ripple-form; very fine sand also collected at the foot of the step. The greatest amount of coarse material accumulated on the surface of the upper beach.

With a more gentle initial slope (4–5°) a similar slightly concave wave-formed bench was produced, but the original beach-slope in this case was aggraded. Material from the lower part of the beach was driven up by the strong "send" of the waves on to the upper beach, the angle of which increased to 6 or 7°. The send or swash of the wave is the rush of the water up a beach from the breaking wave (W. V. Lewis, *Geogr. J.* 78 (1931)). There was slight seaward drift of material below the step and oscillatory ripples were produced on the lower beach. Owing to the low initial beach angle, equilibrium of beach profile was more quickly attained.

Sandy beach and high frequency (short) waves

With both relatively steep and more gentle initial slopes the resulting equilibrium profiles again showed the development of three distinct beach zones, but the upper beach consisted of three sections (Fig. 4). The head of the beach was separated by a marked trench or depression from an almost horizontal wave-formed bench which terminated in the step. There was a backwards and forwards movement of sand grains over the bench, its length approximately the length of the oscillation. Below the step the development of the lower beach zone and its oscillatory ripples depended upon the initial angle of the beach slope. With a low angle (4–5°) ripples were numerous; with a higher angle (12°) only a very small quantity of sand collected below the step and the lower beach was greatly attenuated and almost absent.

The higher velocity, and hence greater energy, of these waves resulted in more rapid combing down caused by an almost continual backwash, and this was especially noticeable with the steeper initial beach angle. The well-marked depression in the upper beach showed a very rapid development, again more so in the case of the steep slope. The depression was quickly enlarged; coarse material accumulated in it, and the sand removed in its

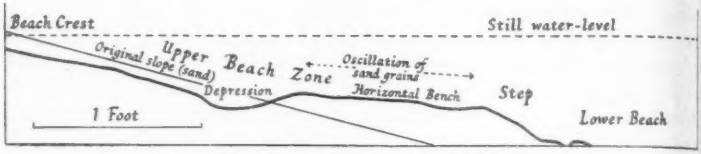


Fig. 4. Beach profile obtained with short waves

formation went to build up the flat bench. The depression was clearly connected with the breaking of the wave and with the eddy motion caused by it, which progressed seawards as the whole beach profile tended to prograde outwards.

Shingle beach

The importance of percolation in weakening the backwash on a shingle beach was well shown; even with short waves the backwash was extremely weak. The whole profile of the beach was steeper, indicating the close relation between the size of beach material and the angle of the beach.

There was less difference in the profiles resulting from the play of long and short waves on shingle than in those obtained with sand. With a steep initial slope (17°) and short waves, no well-defined depression was formed in

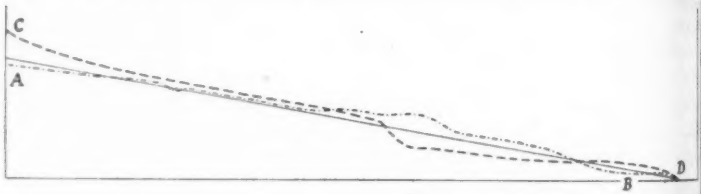


Fig. 5

the upper beach. Combing down of shingle occurred, the beach angle was decreased, and the shingle deposited below the water-level was built up into a flat bench which tended to prograde seawards. Below this bench no movement of shingle was observed; the particles were too large to make ripples. The termination of the upper beach was determined by the limiting depth of effective movement by the waves.

With long waves the strong uprush prevented great down-combing, but a steep initial slope (16°) was reduced and a concave upper beach was formed.

This ended in the beach-step, as usual, below which no material accumulated. Shingle piled up at the head of the beach owing to the great power of the send. The step, which in all experiments marked the main break of slope in the beach, was considerably more seaward in the case of the short waves, and this difference was particularly noted with a shingle beach. The upper beach was wider with short waves, but was of less height than the corresponding feature produced by long waves (Fig. 5).

With gentle slopes (2 and 6°) short waves caused only a slight effect and a step-like break of slope marked the seaward termination of a poorly developed flat bench. Long waves caused a shortening of this upper zone which retreated landwards and also gave rise to a small shingle ridge at the head of the beach. Long waves on a gently sloping shingle beach always built a ridge at the head, even when the water-level was altered.

Conclusions

It is clear that the differences in the profiles obtained were due not only to variations in the composition of the beach and in its initial slope, but also depended upon the frequency of the waves that played upon it. Waves of relatively low frequency (long waves) gave a faintly concave send-backwash (Lewis) slope with pronounced seaward termination. Movement of particles on the floor of the trough was considerably greater than with short waves and gave rise to ripple formation when the beach material was sufficiently fine. It is known that long waves under natural conditions are associated with greater bottom movement, and probably the ground-swell is an important factor in beach configuration. In every case the initial slope was adjusted to the mature profile of equilibrium which fitted the particular conditions. The flattening concave profile of the upper beach invited comparison with the concept of the thalweg of a mature river. It was with shingle that the power of the send of the long waves was most clearly revealed in the piling of beach ridges.

Waves of relatively high frequency (short waves) gave invariably with a sandy beach the distinct depression in the upper part of the profile, but percolation appeared to hinder its formation in a shingle slope. The short-wave profile reached equilibrium more rapidly than with lower-frequency waves; similarly the greater down-combing determined the angle of the terminating step, which was much lower, and the strong eddy which preserved it with long waves was here lacking. Bottom movement of sand was only noticed when the initial slope was sufficiently gentle to allow motion set up by the waves to be felt. Hence, ripple development depended not only upon the nature and size of the beach particles, but also upon the type of wave playing upon the beach and the original beach angle. In general, short waves gave an extended upper beach, long waves made its extent more limited.

The beaches resulting from Bagnold's work appear similar to the long-wave profiles obtained in these experiments. The development of a trench or depression, which was such a conspicuous feature in the upper beach, was not recorded by Bagnold, but he noticed that erosion took place when the "surface was disturbed by a train of short choppy waves" and "the removed

material collected farther down to form a step." It appears that the concave profile obtained by Bagnold with long waves is substantially modified with waves of higher frequency, irrespective of the grain size and wave amplitude.

It is evident that the beach profile is determined largely by the type and frequency of the waves that play upon it. The nature of the beach material and the original beach angle are secondary considerations which modify the profiles that result from the work of the waves themselves. This fact perhaps may help to throw light upon the variations of the beach profile due to changes in the weather, when it is probable that corresponding changes in wave type occur. It is possible, also, that under natural conditions, varying types of waves may play upon a beach almost simultaneously, wave movement off-shore being entirely different from that nearest the beach. Experiments in the Wave Trough indicate to what extent laboratory methods may be used to supplement actual field observations.

Thanks are due to Mr. W. V. Lewis for his guidance in the laboratory and for assistance in writing up these results and to Miss E. L. Elliott of Girton College, who helped with the experiments.

DISCUSSION

Before the paper the PRESIDENT (The Rt. Hon. Sir GEORGE CLERK) said: The reader of the paper this afternoon is Miss Marjorie Sweeting, a graduate of Newnham College, Cambridge, who will describe the wave-trough experiments on beach profiles which she made at the Physical Geography Laboratory in the Department of Geography at Cambridge. We have recently had in the *Journal* an account of this laboratory by Professor Debenham and the present paper is the first to be published on the research work of the laboratory.

Miss Sweeting then read the paper printed above, and a discussion followed.

The PRESIDENT: Perhaps Major King, Professor of Geology at University College, London, would like to comment on the paper.

Major W. B. R. KING: I am sure we are all very grateful indeed to Miss Sweeting for giving an account of her work because work of this type will enable us to sort out the very variable effects which are acting on the coasts. Until we know the working of each individual type of wind or wave on beach material we cannot hope to understand the development of the coasts.

There is one point which I should like to raise; surely it is to be expected that as long as one starts with the same material and the same waves working over sufficient length of time one ought to produce the mature profile for those conditions, no matter whether the beach starts with a steep or gentle angle.

Another point which has struck me as being of interest is that when one looks at coasts at the present time, taking sand coasts in particular, one finds that some of them are marked with very strong runnels parallel to the coast; others have the normal smooth parabolic form. They seem to be subject to the same type of waves and made of the same type of material. I shall be glad to hear any views as to why there should sometimes be one and sometimes the other and also regarding the origin of those strong runnels.

On the question of the grade of the boulders on a boulder beach I think Mr. Lewis will bear me out that certain boulder beaches we visited together had a very strong concentration of big boulders on the lower half of the boulder beach and finer material on the upper part.

The PRESIDENT: Perhaps Mr. Lewis, who has directed research in the Physical Geography Laboratory, would contribute to the discussion.

Mr. W. V. LEWIS: I need hardly mention the pleasure with which I have listened to Miss Sweeting. I would like to add here that it is due to her efforts and to those of her colleagues at Cambridge that simple demonstrations were turned into serious experiments, if not actual research. We have been fortunate in that the high standard set by Miss Sweeting has been well maintained, and, with increasing experience, results have improved. Full credit should however be given to those who did the initial spade work.

Miss Sweeting referred to an early paper of mine, and the wave-trough experiments do seem to support some of those preliminary observations. But I want to utter a warning lest this apparent support should encourage a too dogmatic acceptance of the remarks then made. When the whole story is known, there will be many complications which were not then envisaged.

I am, of course, an unrepentant believer in the value of laboratory experiments, always provided that such work does not replace but merely supplements field work. We were a little concerned lest in scaling down the experiments we lost something vital, but we have been encouraged to see, time after time, features reproduced in the laboratory which we know so well on the seashore. Further, we produced the same features on very different scales in the laboratory. So we feel that the problem of scale is not insuperable though, of course, it must be watched very closely.

A point to bear in mind in Miss Sweeting's experiments is that the piston forming the waves is not well designed. Professor G. I. Taylor tells us that the piston giving the same horizontal displacement throughout its depth should be replaced by a bending plate. This should be arranged so as to give a maximum horizontal displacement at the surface, this displacement falling off with depth (in more than simple proportion) to zero at the bottom of the trough. Such a piston will be designed when work restarts in the laboratory after the war. Thus the waves we were using had probably too much bottom movement compared with wind-formed waves. Piston-formed waves however tend to become more natural as they traverse a long trough.

In trying to consider how these profiles develop it might be helpful to relate the steepness of slope to the relative strengths of the opposing wave-forces. With a long-wave profile there is a long sweeping foreshore slope interrupted just below water-level by a marked step. This break of slope seems to correspond with the seaward limit of the backwash, it represents the lowest point which dries out under the trough of the wave, or, as Mr. Manley once suggested, the base level of foreshore erosion. The returning backwash often sets up an eddy in which the water moves landwards up the steep slope of the step. Thus this latter slope is subjected to a powerful landward eddy current, as the trough of the wave passes. Under conditions of equilibrium, that is, when the same amount of material is carried up and down this slope as the wave passes, a steep seaward slope is therefore necessary. Pursuing this argument, the gentler slope above is due to the smaller difference between the thrusts of the send and the backwash in this upper zone.

With short waves the profile is more complicated. The step is much farther seaward, and inshore—where the waves finally break—one or more reversed slopes might occur. Where a reversed slope occurs the seaward forces are, presumably, stronger than those acting landwards. This seems to be due to the powerful seaward motion of the bottom water in the final swift orbital motion as the wave curls over and breaks, so that even as the crest passes the effective bottom motion is seawards.

Experiments such as Miss Sweeting has described should contribute towards the solution of the problem of the moulding of beach profiles by waves; a problem which Dr. Harold Jeffreys assures us is not yet susceptible to mathematical treatment. Slow motion ciné films, such as the excellent one shown, which was taken by Professor Debenham, will greatly help, but the essential basis of study will long remain careful measurements such as those made by Miss Sweeting and her colleagues.

The PRESIDENT: Dr. Alan Wood is here from the Imperial College of Science and Technology. Would he add a word or two?

Dr. ALAN WOOD: I would like to congratulate Miss Sweeting on her clear exposition of this phenomenon. It is interesting to me as a geologist to see these experiments carried out under control conditions: experiments designed to elucidate the queer things which happen in nature.

One point that struck me during the paper was as to the grading of the material. Some time ago I tried some tentative experiments on river action, and I found it extraordinarily difficult to get the right material to work on. If one tried to feed material to the river, as soon as one stopped feeding the conditions were changed and the whole experiment was nullified. In this beach experiment there is no flow of material away such as one finds in river action, and it seems that grading of the material used may not be quite so important. But I would like to ask the lecturer how the material was chosen. Was it sand from an actual beach, or from some geological strata which had been deposited presumably by marine action, or was it sand made up in the laboratory to a given formula? I think the results will be different if the sand is carefully graded, and they will probably again be different if the sand is carefully mixed.

The Rev. D. BRITT-COMPTON: While carrying out experiments with Mr. T. Cook, of St. Catherine's College, in the Physical Geography Laboratory at Cambridge on the action of waves on a model sand form, we obtained results which corresponded to some extent with those which Miss Sweeting has put before us. We were working, not in the wave trough, but in a wave tank which was about 6 feet by 4 feet and about 1 foot deep. At one end there was a wave generator and in this case possibly, as Mr. Lewis has suggested, of a better form; it was not a flexible generator but a fixed one moving about an axis some 2 inches from the base of the tank. The sand form which we used was that of a simple headland projecting diagonally half-way across the tank, the wave generator being at one end. We were using fine to medium sand and the wave had a frequency of about 70 per minute, an amplitude of nearly 2 cms., and a wave length of approximately 75 cms.

After setting the mechanism in motion we found that cliffing took place all round the headland at once. After about seventy minutes the whole beach opposite the wave generator seemed to have reached a state of equilibrium. We could distinguish a threefold system of zoning on the beach. There was first the gently sloping lower beach, then a bar which was originally single but later double, followed by a slight depression, and a concave upper beach terminated by a well-marked ridge, as Miss Sweeting has already indicated. In the far right-hand corner of the tank we had found it necessary to place another sandy beach to reduce reflected waves. Here again a similar process took place, and a similar profile appeared, but not with a double bar at this stage, only a single bar (during later experiments this developed into a double bar). Miss Sweeting has suggested that a bar is due to high-frequency waves. I would like to suggest that the wave type which we found produced bar formation may have been a long wave. It would be interesting to know whether Miss Sweeting would classify the waves which produced these results as low-frequency constructive

waves. Relative to other waves produced in the wave tank we certainly regarded them as long waves.

The PRESIDENT: Dr. Hobson, of the Imperial College of Science and Technology, is here. We should like to hear what he has to say on the subject.

Dr. G. D. HOBSON: There is only one question I would like to ask Miss Sweeting. It is probably one to which I ought to know the answer without asking. Is there any relationship between the frequency of the waves and the sea-floor slope in nature? Does sea-floor slope control frequency in any way, or does the wave frequency control the sea-floor slope? In general, I would like to congratulate Miss Sweeting on tackling this very difficult problem which is not only of interest to geologists and geographers but also to engineers.

The PRESIDENT: Would Miss Sweeting like to answer some of these rather knotty points?

Miss M. SWEETING: I was interested in Major King's point that the same type of wave and the same material should give one a similar mature profile, irrespective of the initial slope, if the experiment went on long enough. I, too, would agree in theory with that, as starting with the same waves and the same material, one should presumably always end up with the same equilibrium profile. But these experiments seemed to show that the initial beach angle did have some effect upon the profile obtained. We may have been at fault in not carrying on the experiments long enough, but as far as could be judged mature profiles were obtained in all cases. The effect of the initial beach angle was most marked with short waves and a sandy beach, where we found that with a steep angle very few ripples were formed while with a more gentle slope quite a number were obtained. In this case it seemed that the initial beach slope determined the amount of bottom movement felt on the beach, hence the profile was altered. With longer waves there was a greater approximation between profiles from steep and gentle slopes. Regarding the question of the runnels, I am afraid I cannot give any answer. Varying types of waves may have some influence, but I cannot say so definitely.

Dr. Alan Wood asked what sand was used. It was obtained from a Pleistocene sand pit near Cambridge, but was not graded though it was sieved at the beginning and end of the experiment. It had been intended to use various samples of beach sand from beaches around the British Isles, but time was not available.

The Rev. Britt-Compton mentioned the bar obtained with the wave tank. I remember seeing that very clearly. The waves in the wave-tank may be compared with those in the trough by means of the ratio h/t^2 where h=amplitude of the wave and t=wave frequency. For long waves in the wave trough this ratio is 2·4 and for the shorter waves it is 4·5. The ratio for the waves the Rev. Britt-Compton was working with was 2·7, which is nearer that obtained for the long waves in the wave trough. Mr. Lewis stated that on a beach waves of 3 feet amplitude and frequency of 9–16 per minute, are usually short waves with amplitude/frequency ratio of approximately 4. Large waves of 4–8 per minute give a ratio of approximately 1. This seems to suggest that the longer waves obtained in the trough are still somewhat short when compared with those obtained naturally.

Dr. G. D. Hobson inquired about the relation of the sea-floor slope to the wave frequency in nature. In the wave trough, as far as one can judge, the wave frequency controlled the shape of the sea floor. In nature the process is very complicated and the depth and shape of the sea floor certainly have a marked influence upon the waves.

The PRESIDENT: We have heard a most interesting if rather recondite paper,

and also some interesting observations upon the paper. There is nothing more to do now except thank our lecturer and those who have contributed their observations afterwards for a most interesting afternoon.

Mr. J. A. Steers sends the following contribution:

I was sorry that I could not attend Miss Sweeting's paper. I have read the proofs with profit, but have not seen the text figures. She is to be congratulated upon an interesting series of experiments and results. The general agreement with Lewis's views that waves of high frequency caused down-combing of the beach, whereas those of low frequency led to beach construction is significant. The conclusion that long and short waves had less effect on shingle than on sand applies, I take it, to a wholly shingle beach, and not so much to the type of beach so often found around our shores only: a gently sloping and almost pure sand beach backed by a ridge of shingle as worked upon by the waves at high water or in storms. I hope Miss Sweeting will have opportunity of applying her laboratory experiments to actual beaches. It should not be difficult to apply the general technique used in the laboratory to real beaches. This has been done to some extent in America, and it would be fairly easy to find suitable piers in this country (see E. C. Lafond, "Sand movements near the beach in relation to tides and waves," *Proc. Sixth Pacific Science Congress*, 1939). In this way the important factor of change of level and depth of water with the tides would enter into the observations. The ideal cases that can be examined in a laboratory experiment help considerably, but the interrelation of the varying factors working upon natural beach cannot well be reproduced. On the other hand, the difficulties which have to be overcome in the laboratory do help to eliminate or minimize some of those which arise in the field. I do not think we shall get what we really want until long and large scale operations are carried out, in much fuller development of the methods suggested by Lafond at La Jolla, California, at selected parts of our own coasts. In saying this I do not in any way wish to criticize laboratory methods, still less to detract from the value of Miss Sweeting's paper, but I do urge that the two types of work, *i.e.* laboratory and field, should go on together.

MAJOR LEONARD DARWIN, R.E.

Council 1890–93. Hon. Sec. 1893–1908. President R.G.S. 1908–11. Vice-President 1911–18

MAJOR LEONARD DARWIN was the fourth and last surviving son of Charles Darwin. He was born in 1850, educated at the Royal Military College, Woolwich, and commissioned in the Royal Engineers in 1871. From 1877 to 1882 he was an Instructor at the School of Military Engineering at Chatham, and on the staff of the Intelligence Division at the War Office from 1885 to 1890, when he retired with the rank of Major. During his military service he was a member of important scientific expeditions, notably those to observe the Transits of Venus in 1874 and 1882. In 1874 he observed at a station in New Zealand. In 1882 he and Captain Morris, R.E., were the official observers at Brisbane, but dense cloud and rain forbade any observation. But at that time the longitudes of all the Australian stations were doubtful. So

Captain Darwin returned *via* Singapore and made the necessary interchange of telegraphic signals with Port Darwin, thus completing the chain and making one of the most valuable indirect results of the whole enterprise. In 1886 he and Arthur Schuster observed the total solar eclipse of August 29 at Prickly Point, Grenada, B.W.I., photographing the corona, and the solar prominences with a prismatic camera. His long report published in the *Philosophical Transactions*, R.S., gives an interesting account of their pioneer efforts.

Having joined the Society in 1887, he was elected to the Council in 1890, was one of the Honorary Secretaries from 1893 to 1908, during the whole Presidency of Sir Clements Markham (1893–1905). Major Darwin was, in the words of the 'Record of the R.G.S.,' endowed with a large share of the wisdom and capacity which had distinguished his family for generations, but "his greatest qualities were his balanced judgement and his instinctive knowledge of the right moment to intervene in the settlement of disputed points. . . . He commanded the respect and confidence of all sections of the Society, and on the Council he exercised a moderating influence which did much to smooth the transition from the régime of two energetic and reforming Secretaries to that of the masterful and impulsive President."

The new Honorary Secretary was soon deeply engaged as Chairman of the Executive Committee for the Sixth International Geographical Congress to be organized by the Society in 1895, and the official report of that Congress shows how important a part he played when colleagues broke down from overwork.

Major Darwin was elected President of the Society at the Annual General Meeting of 25 May 1908, the retiring President, Sir George Goldie, commending him to the Meeting for his exceptional knowledge of the Society's working and his especial fitness for election at that time because the next year was the Darwin centenary. In accordance with the then custom the new President took the chair at the Anniversary Dinner on the same evening and at the remaining meetings of the Session on June 15 and June 29. At the latter he presented the Patron's Medal to H.S.H. the Prince of Monaco, who had been unable to attend the Annual Meeting in May.

In the first year of his Presidency it was his good fortune to preside at a whole series of very important meetings. On 28 January 1909, at the Albert Hall, Shackleton received the Special Gold Medal awarded him for the expedition in which he had attained in the Antarctic the highest latitude up to that time reached by man. Also on February 8 at a meeting in the Queen's Hall Sven Hedin described his journeys in Tibet of 1906–8, and at a subsequent Afternoon Meeting on Tuesday February 23 there was the celebrated discussion on the ranges of Southern Tibet and the name Trans-Himalaya proposed by Hedin (see *Geogr. J.* 33, 396, where however it is not made clear that the paper entitled "Discoveries in Southern Tibet" was read at this additional meeting outside the ordinary programme). "With regard to the name of this range," said the President in summing up, "I intend to say but little. He has told us that his proposal has been approved by the Viceroy. Possibly he will think I am prejudiced when I tell him that my belief is that this question will be settled in a way I have been taught to believe an immense number of questions have been always settled, and that is on the principle of the survival of the fittest." It was perhaps at an informal dinner following this Afternoon Meeting that the President had Sven Hedin and Aurel Stein seated on either hand and Stein produced a tape measure that had been lost north of Lop-nor by Hedin six

years before; which being then restored to him, was handed to the President for the Society's Museum. A fortnight later on March 8 Dr. Aurel Stein read his paper on "Explorations in Central Asia 1906–8," and in his closing remarks Major Darwin referred to the tape incident when "I happened to be sitting between Dr. Stein and Dr. Hedin at a dinner" (*Geogr. J.* 34, 266).

In his first Presidential Address to the Society at the Anniversary Meeting of 24 May 1909, Major Darwin was thus able to refer to the past year as a red-letter year for geographers. But he thought it necessary to depart from the old custom of a brief summary of the main geographical events of the year, partly because the *Journal* appeared with perfect punctuality every month, but more especially because the time had come to consider how to house the Society in premises more suitable than those it then occupied in Savile Row, which had become inadequate for the ordinary needs of the Society. There was insufficient room for its collections of books and maps; there was no room for Fellows to work or to meet their friends; and the hall in which the meetings were held, the old lecture theatre in Burlington Gardens, was used by the courtesy and consideration of the Civil Service Commissioners and might at any time be unavailable, while "as to its acoustic properties and as to the comfort of the seats, all that I can say is that we must not look a gift horse in the mouth." He proposed then as an aim of the Society to erect an Explorers' Hall to commemorate the deeds of great British geographers, and at a Special General Meeting, which immediately followed, he submitted on behalf of the Council a resolution "that it is desirable to build or purchase elsewhere or to rebuild the existing House, to include in either scheme an Explorers' Hall for the meetings of the Society, and to create a Building Fund for such purposes." These resolutions, unanimously adopted, were a first step towards the movement which Lord Curzon completed three years later.

During Major Darwin's second year of office Peary returned from the North Pole, and on 4 May 1910 received at another Meeting in the Albert Hall the Special Gold Medal awarded him "for Arctic exploration 1886–1909." These words on the medal have been held by the ill-disposed to imply that it was not a clear recognition by the Society that Peary had reached the Pole. It may be well, then, to quote from the President's introductory speech: "I stand here to-night as the representative of the Royal Geographical Society, and, armed with the full authority of its Council, to welcome you, Commander Peary, as the first and only human being who has ever led a party of his fellow-creatures to a pole of the Earth." And in presenting the medal the President said: "On the very day on which we heard of Commander Peary's safe return, I sent him a telegram of warmest congratulation in the name of this Society."

A few days before Dr. Cook had, in the words of the 'Record,' "returned from the Arctic regions announcing that he had travelled to the North Pole over the frozen sea accompanied only by two Eskimo. Some polar authorities were disposed to accept the claim and urged the President to telegraph the congratulations of the Society; but he felt doubtful, so conferring with other experts, who held that more definite proofs would be required before the claim could be admitted, he refrained. . . . Darwin consulted everyone who had a right to be heard; but he did so privately, weighed one opinion against another, and without haste or undue delay he acted as his own strong commonsense directed." When controversy ran high and attempts were made to induce the Society to adjudicate on the rival claims, he held that any critical inquiry that was necessary should be made by the authorities of the country to which the explorers belonged.

In his second Presidential Address Major Darwin had to deplore the death

of King Edward VII who had, both as Prince of Wales and as King, honoured the Society so often by his presence at its most distinguished meetings and by receiving explorers both British and foreign upon their return. Turning then to exploration, he remarked that "Although the majority of Arctic explorers have declared that to reach the pole was not their main object, yet as a fact their lines of advance have generally been as nearly due north as circumstances would permit, and in their heart of hearts the hope of some day standing on that particular spot on the earth's surface has always been as a loadstone dragging them northwards. At last this feat has been accomplished, and the year 1909 will be known in geographical history as the year of the North Pole. Commander Peary never concealed his ambition in this respect, and we may perhaps draw the moral that when any circumstance does in fact exist which affects our actions, it had better be made known to the world." He looked forward to the year 1911 being known in like manner as the year of the South Pole and discussed the analogies between the methods of war and of science in the conduct of an attack. Finally he dealt further with the progress of the Building Fund and with the project of a Memorial Hall in which to record the names of great explorers.

During his three eventful years of office, then, Major Darwin had presided at two Albert Hall Meetings, of which there have been in all only seven, and presented two Special Gold Medals, the last two of the five which have been designed and struck in the life of the Society. His third Presidential Address, on the last day of his office, took a philosophical turn. "We must sooner or later face the fact that the work by which this Society has become best known in the past represents an almost finished chapter in geographical history, and we should sometimes, in preparation for the future, ask ourselves what ought to be our role when the last leaf in that chapter has actually been turned. . . . All great changes take place gradually, the process of evolution being as a rule an advance made by a great number of small steps; and no sudden geographical revolution need be feared. To move with the times ought not to be very difficult therefore, and to do so it is mainly necessary to look to the immediate future, or to take 'short view of things,' to use the words of that wise man, Sydney Smith. If this policy be steadily pursued, there need be no cause for alarm for many years to come at all events. . . . We ought to direct our efforts with more persistence than heretofore in encouraging travellers to make systematic and detailed examinations of comparatively small areas, and not merely to cover long distances with the result of doing little more than confirm the impressions of previous explorers. . . . The more closely this army of workers in detail succeed in covering the ground, and the more completely their foundations are built over with a superstructure of theory, the less will become the probability of any of those great leaps in advance which in the past have done so much by their dramatic suddenness to arouse the interest of the unscientific world. The impediments to further progress . . . will be more felt as time goes on, and it is but natural that geography, which is one of the oldest of all the branches of learning, should encounter such troubles at an earlier date than some of her neighbours. . . . Many attempts have no doubt been made by our Presidents and others to mark out the boundaries of our province by defining the word 'geography'; but the effect of these pronouncements does not appear to have been very marked. It is questionable whether as much is not lost as gained by rigid definitions."

The three Presidential Addresses to the Society, and one on Africa, delivered as President of the Geographical Section of the British Association,

meeting at Liverpool in 1896, make his principal published contributions to geography. After his three years of Presidency, he served, as is usual, as Vice-President for a few years, but in the meanwhile had become President of the Eugenics Society, to which he gave for many years his principal scientific attention, and he had not been seen at the House of our Society for many years though he wrote occasionally on matters of the Society's business. In his home at Cripps Corner, Forest Row, he lived to the great age of ninety-three. He was able to walk round his garden on the Monday, developed bronchitis on the following day, and died peacefully on Friday, March 26.

To this outline of our Past-President's great services to the Society two of those who served with him wish to add their personal appreciations.

Major Leonard Darwin was President of our Society during the three years 1908–11, and during those years I was one of the Honorary Secretaries, so that I saw a good deal of him and of his methods of work. In the office of President he had succeeded Goldie, who had himself followed Clements Markham, whose reign had lasted for twelve years. Keltie was still Secretary of the Society.

Darwin impressed us all by his patience and fairness. His patience was exemplified by the fact that he suffered in silence the loquacity of one of the members of the Council, who would persist, during Council meetings, in talking of extraneous matters to his next-door neighbour, whoever that might be. His fairness was shown by his attitude to the Trans-Himalaya controversy during Sven Hedin's visit to this country in 1909.

His Presidential speeches were useful and to the point. He told me that whilst he remembered the heads and subject divisions of his intended speech, he purposely tried to avoid committing to memory the actual words to be used—a valuable hint.

Darwin, who had been commissioned in the R.E. in 1871, some years later passed through the Staff College, and afterwards became a Staff Captain in the Intelligence Division of the War Office. Whilst in this appointment he published, in 1890, by War Office authority, a useful memorandum on the projection of maps for military purposes, in which he made use of O'Farrell's elegant construction. This small piece of work still remains of value. However, when our Society wrote to congratulate him on reaching the great age of ninety, he said in his answer that he had little pretension to being a geographer. But the field of geography is not limited to mathematical technicalities, and Leonard Darwin had the breadth of view and the keen interest in the human side of the subject that specially befit a leader of the Society, and he can be reckoned as one of our most able and successful Presidents. C. F. ARDEN-CLOSE.

Leonard Darwin and I became friends just fifty years ago, when he was one of the Secretaries and I Librarian of the Royal Geographical Society, then bounding forward under the enthusiastic leadership of Mr. Clements Markham as President and the skilled guidance of Mr. John S. Keltie as Assistant Secretary. It was a time of planning and reconstruction, of new ideals in education and exploration, new methods of organization and equipment. The 'Record of the Royal Geographical Society' contains a full statement of Major Darwin's services to the Society, and the great qualities of caution, firmness, and wisdom which inspired them. Here I should like to express my appreciation of the personality of the man.

I have had glimpses of his home life, both at Egerton Place, in London, in the

earlier days, and at Cripps Corner in Sussex, during the later years, when I saw a good deal of him, especially during my compilation of the 'Record' of the Society. At all times he was the same calm, quiet, and kindly soul, and his profound wisdom impressed me more and more as he grew older. He never spoke without full consideration, and his views, though wide in their tolerance, were always clear-cut, based on the solid foundation of principle. He was the only man I ever knew whose advice when asked for I could accept unhesitatingly even if I did not like it.

I was struck by his business ability when he was the Chairman and I one of the Secretaries of the Executive Committee of the Sixth International Geographical Congress, which after two years of preparation met in London in 1895.

He always took scrupulous care not only to ensure accuracy as to facts, but to state his arguments so that no one could misunderstand them. He once asked me if I knew anything of Bimetallism, and on my saying "No," he went on: "Then you are exactly the man I want to read the proofs of my book critically, and tell me if it is intelligible." I undertook the task, and we had many interesting discussions upon it.

In his later years Darwin's conversation turned more and more on the days of his childhood at Downe, and on his father, for whom he entertained a profound veneration. He resented the opinion often put forward that the great naturalist, absorbed in his scientific studies, had lost touch with the more gracious things of life; and he wrote an article in *The Nineteenth Century* emphatically denying that Charles Darwin had ceased to be moved by beauty in Nature. I brought to his notice the description of Charles Darwin in Noyes's great poem, 'The Torchbearers,' and we had several talks and some correspondence on the subject. He pointed out some minor errors in fact, but approved the general treatment, wondering how the poet had divined elements of character rarely shown beyond the home circle.

Major Darwin talked much to me also of his learned and eccentric great-grandfather, Erasmus Darwin, the far-sighted thinker who wrote before the close of the eighteenth century:

> Soon shall thy arm unconquered steam afar,
> Drag the slow barge, or drive the rapid car,
> Or on wide waving wings expanded bear
> The flying chariot through the fields of air.

Leonard Darwin suffered many disappointments in his career, but took all with philosophic calm. Latterly he concentrated his attention on eugenics, which he followed with an almost religious fervour, for he told me that his religion was summed up in doing what he could with all his power to ameliorate the lot of his fellow-men, and in eugenics he saw the best hope for the future of humanity. After we had been some considerable time without meeting, he wrote in one of his last letters: "I have now grown a long white beard. Come and see it." Most unexpectedly the beard altered the balance of his features so as to bring out the close resemblance of his massive forehead to that in the portraits of his famous father.

HUGH ROBERT MILL.

REVIEWS

EUROPE

THE UNTAMED BALKANS. By F. W. L. KOVACS. *London: Robert Hale,* 1942. 8×5 *inches;* viii+184 *pages; sketch-maps.* 10*s* 6*d*

The theme of this book is important and worthy of a more detailed treatment than it receives here. Balkan affairs have for long presented almost insuperable difficulties to European statesmen and the post-war settlement in this troubled area will call for all the skill and patience of the peace-makers. For that reason, if for no other, it is desirable to avoid generalizations and over-simplification of the facts of Balkan history and politics. In this respect, the seven maps included in 'The Untamed Balkans' are representative of the book as a whole. They are so simplified as to be almost valueless; Macedonia is shown as being approximately the same size as Romania while the shape of Yugoslavia is badly distorted. An even more serious fault is the inadequacy of documentation of the text, in a work purporting to be a serious study and in which frequent statistics are given concerning financial investments, proportions of populations, and trade returns.

In two respects the author should receive whole-hearted agreement. He does well to emphasize the disruptive influence of power politics in the Balkans, both in the past and at present, and his contention that the location of the Peninsula has played a dominant part in its history will be accepted by all geographers. Again, his argument that the Balkan States are largely peasant societies in which the masses of the people have little political power is a sound one. The present hostilities will inevitably be followed by agrarian reforms, possibly on a revolutionary scale, and it may be that Russian influence will be felt in these changes. But to assert that ". . . whether we like it or not, the Soviet Union is destined to play an increasingly important rôle in the fate of a Europe shattered by the gigantic conquests and death-struggles of the Nazi Reich, by the decline of the French and Italian empires, and by the vanishing of British power on the Continent" (p. 173) seems a little premature. A. E. M.

ASIA

THE LAND OF THE GREAT IMAGE; being experiences of Friar Manrique in Arakan. By MAURICE COLLIS. *London: Faber and Faber,* 1943. 9×5½ *inches;* 260 *pages; illustrations and folding-map.* 16*s*

The land of the great image is the seventeenth-century kingdom of Arakan on the eastern coasts of the Bay of Bengal, the designation referring to the bronze statue of Buddha at Mahamuni, regarded by the orthodox as a contemporary likeness. Mr. Collis has taken as the basis of his description the narrative of Sebastien Manrique, an Augustinian friar, who visited the country twice between the years 1630 and 1635. The Arakanese are a people of Mongoloid origin with a language akin to primitive Burmese. When the empire of Portugal had begun to wane, the kingdom enjoyed a brief period of power and wealth, based largely on the export of rice to India, and it was at this time of prosperity that Manrique visited it. Mr. Collis has paraphrased the relevant portion of the friar's 'Itinerario,' and illuminated it from his own knowledge of the country, his examination of the sites, and the researches of Burmese scholars.

Manrique was not the sole or the first European to describe Arakan; other Portuguese, English, and Dutch adventurers and merchants have left accounts, but his is said to be one of the most graphic. A resolute and zealous missionary

and a successful envoy, he made a strong impression upon the King, and to this he owed much of his opportunity to learn something of the people, their history, customs, and religion. He does not however seem to have put himself out greatly to extend his knowledge—he never went to the shrine at Mahamuni, for example—partly no doubt because of his attitude to other religions than his own and his inability to comprehend the significance of all he saw. Some of the incidents he records appear at first sight conventionally romantic or incredible, but it appears that later research has not discredited him.

Mr. Collis' interest in Arakan however is not limited solely to Manrique's account: he gives the episode a much wider significance as part of the contact between two conceptions of world domination, the Christian Portuguese and the Buddhist Arakanese. The first portion of his book is therefore a lively account of Goa and its social life, the centre of Portuguese rule in the east. In contrast to this splendour and power, it might appear to western eyes that the king of Arakan's ambition was merely ridiculous. This very disproportion however provides much of the interest of the author's interpretation of Arakanese history. He argues that, through the possession of the Mahamuni Buddha, the sacred white elephant captured from the Burmese, and other esoteric symbols, the king believed he held the elements of world dominion. That he was impelled, when the political combination against the Mogul power for which he strove came to naught, to resort to sorcery, ending in his own murder, is shown to be in keeping with the spirit of the country. The course of his exposition affords Mr. Collis ample opportunity to develop sympathetically his views upon the contact of cultures and the driving power of different faiths. Narrative and comment are skilfully blended, and the whole captures the imagination of the reader.

Manrique's complete itinerary, translated by Colonel C. E. Luard and Father H. Hosten, was published by the Hakluyt Society in 1926. It will be seen however from the above note that Mr. Collis presents much more than a mere summary of this translation. G. R. C.

LITTLE CHINA: the Annamese Lands. By ALAN HOUGHTON BRODRICK. *Oxford: University Press*, 1942. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xii+332 *pages; illustrations and sketch-map.* 18*s*

In English literature of travel and anthropology French Indo-China is a neglected subject. Students of oriental culture have tended to turn either to India or to China, the lands from which the civilization of Indo-China was derived, while to travellers and tourists the country is chiefly known by the fame of the Khmer ruins of Angkor in Cambodia. The significance of the role of Annam as a centre of cultural diffusion in the past and as the last surviving home of ancient Chinese imperial rites has too often been overlooked.

Mr. Brodrick's book therefore fills a gap and, it is to be hoped, will stimulate interest in this part of Asia. As the sub-title implies, he is not concerned with the well-known ruins of Angkor, or indeed, with those parts of the French protectorate which are inhabited by stocks whose culture derives from India. The Annamese lands are the plain of Tongking in the north and the coastal strip reaching down to Cochin China in the south; the lands which received and retain a Chinese culture. The author shows plainly how this culture follows the flat lands where rice can be cultivated and fails to penetrate the forest-clad mountains or the jungles of the south.

A valuable section of the book is devoted to the Imperial Sacrifices to Heaven and Earth still maintained by the Court of Annam at Hué, the capital. These rites, a strict reproduction of the Imperial Sacrifices of old China, are of

immense antiquity, and since the fall of the Manchu empire they have been discontinued in China and are now only performed by the Annamese court.

The author also gives some space to the non-Annamite peoples of the hill country, tribes who are closely akin to, or actually branches of, peoples found in the neighbouring Chinese provinces of Yunnan and Kwangsi. It is to be regretted in this section that the author uses the term Lolo, which is in fact only a western Chinese slang term, meaning a basket, and is loosely applied to the people properly called Nosu owing to their custom of erecting a basket on a pole on their grave mounds. In general the Chinese names Miao, Lolo, and Man Tzu are rarely to be trusted. A Chinese, even a western Chinese, will call any tribesman Miao Tzu, Lolo, or Man Tzu, without distinction, and the only one of these names which has any true significance is Miao—without the contemptuous diminutive Tzu.

Mr. Brodrick has some interesting observations to make on the psychology and temperament of the Annamites. It would be of value to inquire whether the sense of frustration which he finds characteristic of the educated Annamite is the direct consequence of his subject status or whether it is due to an indirect result of French rule, the separation of Annam from the dynamic forces in the Chinese culture which are reshaping the civilization of the Far East. C. P. F.

LETTERS FROM SYRIA. By FREYA STARK. *London: John Murray*; 1942. $7\frac{1}{2} \times 5$ *inches;* x + 194 *pages; illustrations and sketch-map.* 9*s*

Miss Freya Stark is a witty and colourful writer with a nice Latin sense of scholarship; a graceful recorder of fugitive impressions; fond of strange people provided they are contented with their lot and very fond of the ways in which they dress themselves; a plucky traveller adventurous to the uttermost limits of her strength and beyond. All this we knew from her previous travel books. The latest volume consists of letters written about fifteen years ago on a first journey to the East and it displays the same qualities in embryo. The letters, which make pleasant reading, are about such well-trodden regions as the Lebanon, Damascus, and the Druse country. In the Lebanon Miss Stark spent a winter in missionary circles and naturally suffered from the cold: in Damascus where she lived in the house of a native Christian she suffered as naturally from dirt and the food; through the Druse country she travelled on a donkey and found the people much more sympathetic.

Miss Stark is now somewhere in the East again and Sir Sydney Cockerell has seen the book through the press most admirably. The editing indeed has been too religious, for it preserves spellings like Sharlan, Achmed, Iachya, and others which date from a period in Miss Stark's Arabic studies she has now left long behind. J. W. C.

AFRICA

THE DIARY OF A DISTRICT OFFICER. By KENNETH BRADLEY. *London: Harrap*, 1943. $7\frac{1}{2} \times 5$ *inches;* 192 *pages; sketch-map.* 5*s*

In the introduction to this book, Lord Hailey writes of the District Officer that "it is on him that the reputation of the Government, no less than the contentment of the district, largely depends." Mr. Bradley gives a picture of the life of a District Officer in the Fort Jameson district of Northern Rhodesia. The account may appear somewhat light-hearted, but the importance of the work which the District Officer does, the exceptional individual responsibility, and the differences of the work under Direct and Indirect Rule, all underlie the gaiety. The author has a remarkable ability for painting word-pictures: "The sun, dulled by the smoke of our forest fire, set a sheen of gold on leaf and stone,

so that we passed silently through an unreal world, dead and glittering and hard. An *impala* doe, her russet coat gleaming for an instant in the sun as she bounded silently away, only emphasized its lifelessness." Combined with a pleasant sense of humour, this makes a most enjoyable account. D. R. C.

CENTRAL AND SOUTH AMERICA

HERNAN CORTES, Conqueror of Mexico. By SALVADOR DE MADARIAGA. *London: Hodder and Stoughton*, 1942. 9×6 *inches;* x+554 *pages; frontispiece and sketch-maps.* 21*s*

This important book may be regarded as a companion to Señor de Madariaga's biography of Columbus, but it has a very different atmosphere; for while the story of Colón is mainly one of fanaticism and frustration, the tale of Cortés is chiefly, almost to the end, one of success. What is more, while it was to be perceived that the author really did not like Colón very much, he is enamoured of Cortés, and so we get a book written almost invariably with enthusiasm. Cortés is to Sr. de Madariaga what a hero should be: noble, courageous, wise, and magnanimous, and if one does not always agree, the pages remain fascinating.

The story of the conquest of Mexico is one of the greatest and most terrible adventure tales in history: non-Spanish lovers of Mexico cannot regard it entirely with the eyes of the Spaniard, and will sympathize with the "erection of a statue to Cuauhtemoc" of which the author speaks on p. 485. There are however certain indications in the final chapter that Sr. de Madariaga himself recognizes the downfall of Mexico as the first of the great American tragedies—the destruction of indigenous civilizations in the New World, in whose ruins the ethnographer now gropes for enlightenment.

But this being a story of Cortés, not of the Nahuatl peoples, it is complete so far as the records go: the career of the conquistador is traced from his comparatively humble birth through his extraordinary triumphs to his disillusioned end. The standard authorities have been carefully consulted and collated, and if there is very little new material, *i.e.* unknown in Prescott's time, this is perhaps because little more has been discovered. The author relies, of course, considerably upon the immortal first-hand account of Bernal Diaz del Castillo, upon Cortés' own letters, and upon the well-known Spanish historians of the Conquest; he illumines the story with skill and vivacity, and allows his humour, sometimes expressed in verbal quips, a good deal of freedom not invariably acceptable, as when, on the strength of Bernal Diaz' erratic spelling of the name of the god Uitzilopochtli, he has been "tempted" to translate it as "Witchy-wolves."

The Notes are chiefly documentation, and extremely careful; the index is good. The two sketch-maps are entirely inadequate, and readers interested in geography will find it useful to turn up the maps and charts in the Hakluyt volumes containing Maudslay's translation of Bernal Diaz' narrative. L. E. J.

BRAZIL: land of the future. By STEFAN ZWEIG. Translated by ANDREW ST. JAMES. *London: Cassell*, 1942. 8½×5½ *inches;* 282 *pages; sketch-map.* 10*s* 6*d*

Author of numerous biographies, Zweig chose for his last study a country, Brazil. He disclaims any attempt to present a guide to the largest and most populous of Latin American States; confining himself to an analysis of its history, economics, and culture, with some tourist vignettes of the coastal cities and the Amazon. To compress four centuries of Brazilian evolution into two hundred and sixty pages meant that only major issues could be dealt with, and Zweig instinctively dramatizes these. For instance, he attributes the abdication

of the Emperor Don Pedro in 1889 chiefly to his aversion to the traffic in African negro slaves.

In the economic field we are shown Brazil's succession of one-crop export industries, beginning with the dye-wood to which it owes its name, and passing on to sugar, tobacco, to the gold and diamond discoveries, the coffee and rubber booms and slumps; each redeeming the crisis due to its predecessor's decline. Curiously, he makes no mention of Brazil's livestock, to-day computed at some fifty million head of cattle and swine.

Brazil, so runs the theme, is not only a vast, fertile, even over-fertile, and beautiful country; her importance and good fortune are due to the qualities of her people and policy. No other people has shown so much tolerance and kindliness or hatred of cruelty and aggression; no other State has solved so many crises, domestic and foreign, without resort to armed force. In support of this, Zweig, like many commentators, points to the absence of any colour problem in Brazil. Yet he stresses the benefits to Southern Brazil from the white immigration that succeeded the slave traffic.

However, to indulge in criticism is to misunderstand Zweig, for this book is less a study than a panegyric. He is in love with Brazil; an affection which began with a ten-day chance visit in 1936; which brought him back in 1940, and which ended with his death at Petropolis a few months ago. It runs through all his pages: "Brazil is one of the most lovable countries of our world. It is a country that hates war; even more, it has hardly experienced it. . . . So one of our hopes for future civilization and peace in our world, rests on the existence of Brazil. That is why I am writing this book." Even if one cannot agree with many of the author's views one can enjoy his vivid presentation of a country and people too little known to English readers. W. S. R.

AUSTRALASIA

THE BRITISH EMPIRE IN AUSTRALIA: an economic history, 1834-1939. By BRIAN FITZPATRICK. *Melbourne: University Press*, 1941 (*Oxford University Press*). $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xxxii+530 *pages.* 21*s*

Within a century the economy of Australia has undergone a striking series of transformations. In the pages of this volume, distinguished by clarity of exposition and skilful compression, Mr. Fitzpatrick unfolds his interpretation of the transition from English paternal rule to a complex economic and social structure adjusted to the world economy but with notable individual features. Though the physical background is introduced only incidentally, the interest to the geographer is in the delineation of the ideas, aims, and methods of the men who wrestled with, and in part transformed, that environment to fashion modern Australia, and the external influences which forwarded or hampered their progress. The main theme is the interweaving of economic developments in England and in the colonies, with their influence on the political demands advanced and the degree and manner in which they were met, all further complicated by the varying conditions and policies in the individual colonies. It is valuable to have an Australian point of view set out as clearly as it is here.

The first step was the beginning of free immigration, linked in England with the refashioning of the poor law and the repeal of the corn laws, in Australia with the expansion of the great pastoral leases. This provided the ranchers with cheap labour and secured an ample and assured supply of wool for English industry. The colonial opposition to this dominance of the sheep owners, whose services obtained for them the confirmation of their holdings of Crown lands just before the advent of political democracy, found its great opportunity during

the aftermath of the gold rushes, when the permanent absorption of the increased population required agricultural settlement on a large scale, and the first moves towards tariff protection. The importance of the gold to English economy is advanced as the reason for the granting of representative government. Then followed the great influx of capital into State loans and private enterprises which culminated in the 'eighties, and contributed to the material equipment of Australia, providing the railways, the technical plant, and the irrigation schemes necessary for the handling of the increasing wool clip and the developing wheat lands. This phase the author describes as "the story of an economic utilization of the colonies to meet the needs of the imperial country, and to that extent it is no novelty of colonial history"; the novelty lay in the diversified nature and great scale of the utilization, and the private inventiveness and public enterprise which contributed to it; and out of these emerged modern Australia. The author here combats views which he considers are generally and erroneously held outside the country. Australia is not now an extreme case of State socialism, for the State has largely abandoned its ventures into industry, and has assumed the task of smoothing the path for private capital. As regards the complicated history of labour arbitration and wage regulation, he concludes that it is impossible to assess their results and value. In relation to the organization of capital, he details the spread of modern finance monopolies, particularly exemplified in the iron and steel and in the sugar industries, and their affiliations in Britain.

It is in the light of the above that his title is to be interpreted; the British Empire in Australia is economic, not political, and the Australian State is its instrument; his concluding sentences summarize his theme succinctly: "The reservoir of Australian labour and industry has never failed to provide a stream tributary to the broad river of English wealth. The State did much to building the reservoir, it maintains it and it allows no blockage of the stream that flows to Imperial England."

It may perhaps be remarked that this imperialism is of an unusual kind. It is not a case of the imperial centre dictating to subject societies; as Professor Hancock has pointed out in this connection, imperial policy has been shaped in response to demands from members of the Empire, and the latter are free to adjust their economic relations with other powers if they consider that necessary, though it is arguable that interests representing the capital investments can control such a tendency. This is not the place however to attempt to strike a balance between the advantages derived by each party to this association. What it has achieved is set out in these pages, and its shortcomings have their lessons for the future.

G. R. C.

CARTOGRAPHY

BARTHOLOMEW'S WORLD CONTOURED SERIES: New Survey Map of Iceland. By JOHN BARTHOLOMEW. *Edinburgh and London: John Bartholomew*, 1942. *Scale* 1/750,000; $20\frac{1}{2} \times 28\frac{1}{2}$ *inches; folded paper, in paper covers*, 3*s*

This map is a useful contribution to Icelandic cartography. The general colour effect is pleasing and the representation of physical features takes into account all the most recent surveys except those of military origin which are not yet available to the public.

It is rare for maps of Iceland published in other countries to use the correct Icelandic forms for place-names. When partial translations or transliterations are attempted the language usually baffles cartographers and results in every possible variety of misrepresentation. It is most refreshing to find a map in which this problem has been solved by leaving the names with their official

Icelandic spellings. The difficulty of the two Icelandic letters, ð and þ, is met by an explanatory note, which also gives a rough guide to the pronunciation of æ and ö.

The map is layer-coloured in six tones of green and brown, with contours at 100, 200, 500, 1000, and 1500 metres, and numerous spot heights for mountains of greater altitude. The lowlands are brought out well with two tones of green, but the wide contour interval at higher altitudes fails to indicate the extremely rugged nature of the central highlands. Distinction is made between motor roads (*akvegir*), well-defined tracks (*götur*), and rough tracks (*sloðir*), and there are special symbols for glaciers, hot springs, freshwater lakes, "forests", and sandy wastes. The reviewer has no hesitation in recommending this as the best general-purpose map of Iceland that has yet been published. B. B. R.

MAP PROJECTIONS BY PRACTICAL CONSTRUCTION. By A. HINCKLEY. *London: George Philip*, 1942. $7\frac{1}{4} \times 5$ *inches;* 84 *pages; diagrams.* 3*s*

AN INTRODUCTION TO THE STUDY OF MAP PROJECTION. By JAMES MAINWARING. *London: Macmillan*, 1942. $8\frac{1}{2} \times 6$ *inches;* 114 *pages; diagrams.* 5*s*

These two books, remarkably similar in their general purpose and treatment, represent a somewhat new and decidedly attractive outlook; in each case the emphasis being rather more on how to construct the map net than on the technical properties of the projection. Indeed Mr. Hinckley looks on map projections rather as material with which to teach geometry; and in a number of cases the little mathematics required of the student may be strained if he wishes to verify that the projection described does, in fact, fulfil the simple analytical conditions. Dr. Mainwaring's book perhaps strikes the better balance; and the introductory notes on each projection, though short, are probably adequate.

The two books, side by side, present an interesting contrast from the book-production point of view. Mr. Hinckley's has suffered somewhat severely from war conditions, in the compression, sometimes almost to telegram-like brevity, of the mathematical detail; and, to avoid waste of space, in the running over of the text beyond the page which bears the figure. But there is no evidence of war conditions in Dr. Mainwaring's book, which might almost be described as a sumptuous volume. Lightly loaded pages, with full-page diagrams opposite, are the rule; and it is a pleasant and satisfying book to handle. It contains a few infelicities, *e.g.* "the rhumb line would intersect all meridians at the required angle and in places similar to its intersections with the meridians on the globe" (p. 21); a few misprints, though not such as need puzzle the student; and in two places Stereographic has become Stereoscopic.

Each book opens with a few useful chapters on the sphere in its relation to the projections; to which Mr. Hinckley adds a foretaste of what is in store, in the shape of a geometrical construction for obtaining the distance between two places whose latitude and longitude are known. The opening chapters are followed by the construction of some twenty-odd projections, including a good many not usually found even in an advanced atlas. These include cylindrical equal-area and the whole gamut of Zenithals—polar, equatorial (which Dr. Mainwaring calls "normal"), and oblique; while Mr. Hinckley adds, perhaps unnecessarily, cylindrical central and equidistant, more usefully a polyconic, and, most interestingly and ingeniously of all, Murdoch's Third. One would have welcomed a mention of Aitoff's, most graceful of all world projections, and so easily obtained from the Zenithal equivalent: curiously unpopular in this country, and now never likely to be cultivated, as it lends itself to "interruption" less effectively than Mollweide's or the Sanson-Flamsteed.

Dr. Mainwaring adds some useful and well-illustrated sections on the characteristics of the projections and their suitability to particular regions; and ends with a note on the Stereographic as a case of inversion, bringing out the orthomorphic properties of the projection. Mr. Hinckley, evidently with the needs of the embryo Air Pilot in view, ends with a simple treatment of Relative Motion, followed by chapters on "Finding Position from Astronomical Observation," "Time," and "Position Circles and Direction Lines." Both books are plentifully supplied with exercises for working; those in Mr. Hinckley's, the more searching and the more practical collection, grouped at the end of each chapter; and those in Dr. Mainwaring's, including many borrowed from various Higher School Certificate examinations, in a roughly graduated series at the end of the book.

It has been said above that in both books the emphasis is largely on how to construct the map. Therein lies the (may we say?) fascination of Mr. Hinckley's work. Occasionally the data for a drawing have to be calculated; but the book is faithful to its title, and its novel and very attractive feature lies in the fact that every one of the projections dealt with is obtained primarily by geometrical drawing and construction. There is some heavy going in places; and at times Mr. Hinckley might well have simplified the work (or shown how it might be simplified) by a little calculation. But it is a fair guess that he is an enthusiast; and it is not difficult to believe that he has been able to instil some of his enthusiasm into his classes, as he more than hints in his preface. And so we may say, without any injustice to Mr. Hinckley, that Dr. Mainwaring has given us the more practical approach to the subject. Where the geometrical construction is straightforward, he gives it to us, with a simple note on the mathematics of the projection; where, as for example in the Conical with two standard parallels, the construction is more intricate and involved, he gives it to us in a purely mathematical form. The student with average knowledge of mathematics (and both books have the H. S. C. examination in view) will probably find Dr. Mainwaring's book adequate; but if he gets intrigued or attracted by the geometrical treatment of the subject, he will find Mr. Hinckley's a feast. It is safe to say that a student will emerge from a diligent study of either book with a much sounder and more intimate acquaintance with the principles and practice of the subject than he would get from almost any other class text-book yet produced in this country. Every teacher of the subject should have both books.

H. P.

ECONOMIC AND HISTORICAL GEOGRAPHY

VENETIAN ADVENTURER; being an account of the life and times and of the book of Messer Marco Polo. By HENRY H. HART. *Stanford, California: University Press*, 1942. (*Oxford University Press*). 10×7 *inches;* xiv+284 *pages; illustrations.* 22*s* 6*d*

The author's aim is "to present the entire life of Marco Polo in relation to his times and his book," and since there is nothing known of his boyhood and very little of his life after his return to Venice, except that he was captured by the Genoese in some sea fight, and dictated his story in a Genoese prison, there has been plenty of necessity for filling the many lacunae "as realistically as possible, following careful investigations into the life of contemporary Venice and the Mediterranean and Eastern worlds." Thus the long chapter on The Boy Marco is a sketch of Venice of the thirteenth century, of the history of St. Mark's, of politics and morals, crime and pageantry, the installation of the Doge, funerals and dress, glassworks and shipbuilding, which "shaped his plastic young mind through its formative years."

Mr. Hart has deliberately omitted discussion of the Polos' routes, "obscure place-identifications and the like," because he is convinced that they possess little interest except to the specialist. He has instead constructed a narrative of the two journeys which is vague in its geography but illumined with interesting and curious excursions into mediaeval history, the sack of Constantinople by Dandolo in 1203, the slave trade of eastern Europe, the history of the Mongols, and the relations of China with Europe from prehistoric times. With equal industry and learning he has pictured the return to Venice, Marco's captivity in Genoa, the ramifications of the Polo family which may be deduced from the records of marriages, law-suits, and wills, and the traditional stories collected by Ramusio and others. It is all picturesque, if not always as "vivid and sharply etched" as the author purposed. A page on the visit of Dante to Venice before his death at Ravenna concludes with the sentence "All this Marco Polo is likely to have learned."

The tenth and last chapter "Epilogue" sums up "Marco Polo, the Man" as clever, patient, and tenacious, greedy for gain in later years, brave and tactful, humorous, broadminded in religion, egotistic without personal vanity, litigious, of little education, but with a clear and scientific mind, undiscriminating, yet the author of the greatest work of travel ever written. Of his reputed wealth, Mr. Hart is content to accept the calculation of Professor A. C. Moule ('Marco Polo,' I, 31), based on Orlandini's estimate of his estate as proved in his will in Venetian *grossi*, translated into gold ducats of 1283, thence somehow from lire of 1924 at 100 to the pound sterling, and finally by Mr. Hart into dollars at 5 to the pound. It is not surprising that the result is disappointing, only 14,765 dollars.

The author disavows any care for the meticulous scholar, but he does claim that his documents have all been checked in the original. One may therefore be allowed to remark that his bibliography entry "Frampton, John. *The most Noble and Famous Travels of Marco Polo*. London 1929" is an inadequate guide to the Argonaut Press volume of 1929, which reprints Frampton's translation of 1579, with 60 pages of Introduction, 100 of notes, and 10 route-maps by the editor, Mr. N. M. Penzer. Of Mr. Hart's reproductions of early maps, one may note that the 'Map of the World by Fra Mauro' is not from the original but from a sketch (*Abbozzo*) as its engraved title says; and that it is now in Venice, not at Murano; that the title printed under the world map by Johann Ruysch reproduced from Nordenskiold, is inconsistent in title and in date with the legend shown on the Swedish reproduction; and that the Venice Ptolemy of 1574 was edited by Gio. Malombre, not by Giacomo Contarini.

The book is handsomely produced, but the bastard numerals of Cloister Black Text used for the running headlines make the page numbering obscure.

THE MONTHLY RECORD

MEDALS AND AWARDS

His Majesty the King has given permission to the Council to postpone any recommendation for the Award of the Royal Medals for 1943.

The Council have resolved that the Victoria Medal be not awarded in 1943, and that the grant of the Awards for 1943 be postponed.

A NEW MAP OF HISPANIC AMERICA

The remarkable work of the American Geographical Society in compiling and publishing a 1/1,000,000 Map of Hispanic America on the sheet lines and style of the Carte du Monde au Millionième was begun in 1920 and 101 of the 107 sheets were published by May 1942. In 1935 the Society undertook its natural sequel, a map on the scale of 1/5,000,000 compiled with additions to date from the 1/1,000,000 material. The outbreak of war made it desirable to speed up this map and we have recently received the three large sheets, of engraved surface 43·4 by 29·7 inches, covering the whole of the Hispanic series and extending into the United States up to New York on the Atlantic coast. The new map is contoured in brown instead of in black at intervals 200, 500, 1000 metres, and so by thousands, both on land and on the ocean bed, with an improved colour scale of layer-colouring on land changing at each contour, and a colour scale for the depth of the sea changed at every second contour below 200 metres; this difference in rule corresponding approximately to the fact that the ocean deeps are twice as deep as the mountains are high. The contouring in the ocean is complete and indeed very detailed up to Nantucket, but there is no relief of the land north of the Mexican border, the United States being shown with the rivers, roads, and railways, but without even a spot height. This emphasizes the remarkable fact that the whole American continent south of the United States border has been mapped by a scientific society of the United States, and that there are only a few isolated sheets of the 1/1,000,000 map published by the United States Government for itself. The only general relief maps of the United States are the Regional Aeronautical Chart on 1/1,000,000 and the Sectional Aeronautical Chart on 1/500,000 recently published by the Coast and Geodetic Survey for the Bureau of Air Commerce, layer-coloured but contoured in feet.

The American Geographical Society have however in view an ultimate extension of their 1/5,000,000 map to include the whole of North America, and have, we are glad to see, committed themselves to this project by adopting the title 'Map of the Americas 1/5,000,000,' in succession to 'Map of Hispanic America on the scale of 1/1,000,000.' For this a very interesting bi-polar oblique conical orthomorphic projection has been developed at the Society by Mr. O. M. Miller and Mr. William Briesemeister, which was described in the *Geographical Review*, 31 (1941) 100–104. South America is mapped from a first pole in 20° S., 110° W.; North America from a second pole in 45° N. and 19° 59′ 36″ W. The two projections meet along a line running about N.E to S.W. through Panama. They meet but they do not quite coincide except along their standard parallels, and there is therefore a certain adjustment necessary in joining up the other parallels, of which the theory is briefly described in the paper just mentioned. It will be interesting to go into this matter in detail on another occasion, but sufficient for the moment to say that since the bi-polar conical orthomorphic is oblique, the scale along any parallel of latitude is variable, not markedly but easily measurable, and this is an unusual feature. The three sheets make a

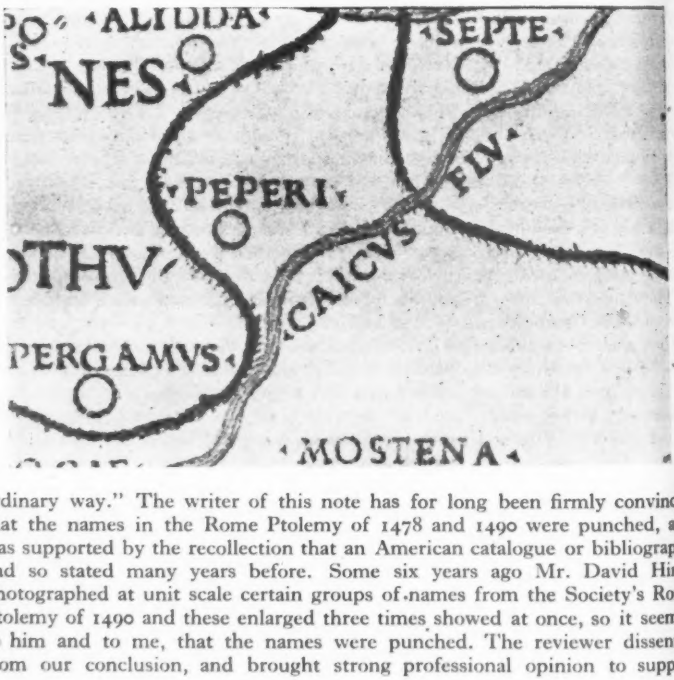
timely and most valuable satisfaction of the urgent need for extensive maps and we shall hope that the North American sheets may soon be completed in the same style.

An interesting diagram on the northern sheet shows the junction of the two projections and the scale values along curves run N.W.–S.E.: the error of scale is nowhere on the land surface more than ±3 per cent. The nominal scale 1/5,000,000 is said to assume an average radius of the earth of 6,378,388 metres. But this is the equatorial semi-axis of the International Spheroid: the mean radius is surely 6,371,220.

The map has, we should judge, the formidable number of 13, perhaps 14 printings. The names, except those on the blue plate, seem to be stamped or printed on labels, in that mixture of rather undistinguished styles imposed upon the 1/M maps by the Paris Conference of 1913. For use with the three sheets there is a full referenced index of names, which bears no price; nor do the maps, but the cover of the *Geographical Review* lists them as $2.75 per sheet. The American Society has very kindly presented two sets to our Map Room. It is a particular pleasure to bring this important map to the notice of British geographers. A. R. H.

THE LETTERING OF THE ROME PTOLEMY OF 1478

The reviewer of "The first copper-plate maps" of the Bologna Ptolemy remarked in a footnote (*Geogr. J.* 100.262) "It has been suggested that the lettering of the Rome maps may have been punched, and not engraved in the



ordinary way." The writer of this note has for long been firmly convinced that the names in the Rome Ptolemy of 1478 and 1490 were punched, and was supported by the recollection that an American catalogue or bibliography had so stated many years before. Some six years ago Mr. David Hinks photographed at unit scale certain groups of names from the Society's Rome Ptolemy of 1490 and these enlarged three times showed at once, so it seemed to him and to me, that the names were punched. The reviewer dissented from our conclusion, and brought strong professional opinion to support

him: but this was before the enlarged photographs, which were stored away in Cambridge, could be produced. When they were retrieved they were submitted to Mr. Stanley Morison and to the Keeper of Printed Books in the British Museum. Mr. Morison replied "I am strongly inclined to guess that the original lettering on the five portions photographed from the Ptolemy, and which you enclosed in your letter, was contrived by stamping, and not by engraving. I do not see how the spacing and alignment of a word like PEPERI on Photograph 2, and a word like SANTONES on Photograph 5, could have been produced by any other means than stamping, in the manner still used by book-binders. The expert view is, I believe, that the practice of stamping a legend on the cover of a binding much antedates the origin of printing, and probably made a contribution to the invention." And Mr. Hind writes "A conclusion would of course depend on the conviction that certain letters were always in exactly the same form and size—which could hardly be so if engraved.

From your enlargements I am inclined to think that the letters and the O for place must be stamped from punches. The consideration of a word like PEPERI with its varying slopes also inclines me to the same view as it would be easier to keep regular parallel letters in engraving than in punching."

A certain variation in the detail of the letters might be produced by striking a little obliquely and so varying the amount of burr to be smoothed away; also by touching up with the graver names imperfectly punched, as well as by irregularity in inking and roughness of paper. The strong evidence for punching is the irregularity of orientation, of spacing, and of alignment, much easier to explain as due to difficulties of punching than of engraving between parallel scribed lines.

But the conclusion is not new, though it seems to have been overlooked until now on our side of the Atlantic. A List of Editions of Ptolemy's Geography 1475–1730 was prepared in New York in 1886 by Mr. Wilberforce Eames, for Sabine's Dictionary of Books relating to America; and a privately printed copy of this list was presented by him to the Library R.G.S. Of the Rome Ptolemy of 1478 he says "The inscriptions were not engraved but were made with a

punch and mallet." He remembers having seen an equivalent statement in the catalogue of some collection of maps in the United States, and will be grateful for reference to any discussion of this interesting technical question.

A. R. H.

ETHNOGRAPHY OF THE NORTH-WEST FRONTIER OF YUGOSLAVIA

The Treaties of St. Germain and Rapallo and the Pact of Rome (1924) defined the political boundary of North-West Yugoslavia. This boundary, based on military, economic, and political considerations, separated over half a million Yugoslavs from the newly created South Slav State. Some four hundred and fifty thousand Slovenes and Croats came under Italian rule while the remainder, almost entirely Slovenes, were included in German Austria, mainly in the upper reaches of the Drava valley. Therefore the ethnographic basis of boundary delimitation was sacrificed to military and economic exigencies, at least two minority problems were created and the seeds of future political discord were sown. The boundary has lasted barely twenty years, and it is highly probable that it will be re-drawn in the near future with considerable modifications.

In his atlas, 'Ethnography of the North-West Frontier of Jugoslavia with Germany on the north and Italy on the west,' Mr. G. M. S. Leader has put together fourteen photographically enlarged copies of ethnographic maps, of American, British, Yugoslav, Swiss, Italian, and German origin, ranging in date from 1845 to 1940. The ethnographic boundaries from each of thirteen of these maps are reproduced on a more up-to-date map which also shows recent political boundaries and railway developments. By placing each pair of maps on one page and by using a bold colour scheme to differentiate between the various ethnic groups, he shows that a large territory, occupied by Slovenes and Croats, was left outside Yugoslavia after the last war. The reader is left to make his own deductions as to the wisdom of this course.

The last map of the series is a "Summary of all 14 versions of the ethnographical boundary of the Slovene and Croatian nationalities of the N.W. frontier." There is a fairly close coincidence between the ethnographic lines of all the authorities whose works have been used in this compilation. Unlike some of the regions of mixed languages and nationalities in Europe, there are no very large overlaps of peoples in this area so that a political line could be drawn to coincide reasonably closely with the ethnographic boundary. How far this will be done will depend largely on the results of the war and the political conditions of Europe at the cessation of hostilities. As Mr. Leader points out, the territorial conflict between Italy and Yugoslavia will be on different lines this time in so far as Italy has deserted her allies of the last war. She will therefore not be in a position to demand concessions from her associates and the delimitation of the boundary of North-West Yugoslavia should not give rise to the disputes which characterized the efforts of the Allied statesmen in 1919–20.

The compiler of the atlas makes no attempt to define the ethnographic limit of the Slovenes and Croats. Indeed, he states that the maps are meant "to serve as an indication of what general area is involved rather than as a definite clear-cut claim which can only be determined after more detailed and exhaustive enquiries" (p. 15). But who is to make these enquiries? And what will be the criteria employed to determine the precise location of the ethnographic boundaries? These are important questions but the answers to them will not provide a complete solution. To parody a famous phrase, "Ethnography is not enough." Geography, history, economics, and politics must all be considered if the future

political boundaries in this part of Europe are to have any hope of success. Fortunately there is a fairly close agreement between the suggestions of all these branches of knowledge as far as this area is concerned so that we may look forward to a more just settlement, particularly of the territorial quarrel between the Italians and the Slovenes. A. E. M.

SOVIET RUSSIA IN MAPS AND PICTURES

The editor of any atlas of Soviet Russia is confronted by many difficulties. Apart from the vast area of the Soviet Union, the uneven distribution of its economic activities together with the complexity of its linguistic and ethnic conditions call for ingenuity in cartographic presentation. In the case of 'Soviet Russia in Maps' (edited by G. Goodall. *George Philip*, 2*s* 6*d*), where presumably because of war-time paper shortage the page size is restricted to $7\frac{1}{2} \times 9\frac{3}{4}$ inches and where each map is accompanied by a short set of explanatory notes, some compression and lack of clarity are to be expected. The largest scale employed is that of 1 : 10,000,000 while that of some of the maps is as small as 1 : 80,000,000.

As Mr. Goodall points out, "Industry still remains concentrated in the west" (p. 23), so that he has done well in doubling some of his maps. By placing maps of European Russia and of the Soviet Union on facing pages, the former on a considerably larger scale than the latter, he has been able to present greater detail of the more highly developed areas while retaining a perspective view of the country as a whole.

The first part of this compact atlas, consisting of thirteen maps, is particularly useful in that it shows the historical development of the Union from the thirteenth century down to 1940. This information is not readily available to the general reader and, as presented here, provides a clear summary of Russian territorial expansion through the past seven centuries, though it is unfortunate that the tints showing the stages of this expansion are not more distinct. The remainder of the atlas, consisting of twenty-nine maps, shows the present economic development of the Union in its geographical setting. The more important industrial regions, such as the Leningrad, Moscow, Ukraine, Caucasus, Ural, and Kuznetsk Districts, are shown in separate maps which supplement the general maps of the whole country. Finally two pages of diagrammatically represented statistical information show the areas and populations of the constituent republics as well as the increases in agricultural and industrial production since the Revolution.

The editor acknowledges his indebtedness to the 'Great Soviet World Atlas,' many more copies of which should be available in Britain, and has been advised by the staff of the Soviet Embassy in London. He has therefore used the best available sources.

To members of Discussion Groups, Study Circles, W.E.A. Classes, and the like, 'Soviet Russia in Maps' should prove of great value, both in spreading knowledge and correcting wrong impressions of a country which is too little known here. Teachers and University students also will find a wealth of material brought together in this atlas which will well repay their serious study.

In several respects the collection of photographs in 'U.S.S.R. Pictorial Survey' (edited by G. D. B. Gray. *London: A. and C. Black.* 9×6 *inches.* 2*s* 6*d*) is complementary to the atlas noted above. It gives pictorial details of landscape, peoples, agriculture, and industry which an atlas reduces to symbols; it puts flesh on the bare bones of the atlas maps and is therefore a useful addition to the geography teacher's equipment. The pictures are well chosen from the wealth of photographic material made available by the Society for Cultural Relations

between U.S.S.R. and the British Commonwealth. They emphasize the great variety of environment and human activity which is characteristic of the Soviet Union. No firm grasp of Russian geography can be made unless this fundamental fact is appreciated at its true worth, and there is no better approach to a realization of the immensity of Russian resources than by a well-directed study of pictures such as these.

The material presented in these pictures is excellent. They are however described as being "For Wall Exhibition, Class Use, Epidiascope, etc.," but they are too small for effective teaching purposes unless each member of the class is supplied with an individual set. Passing them round the class is ineffective as a teaching method because of dissipation of interest and the inability of the teacher to be in more than one place at any given moment. Even when the pictures are mounted as an illustrative addition to a map their value is reduced by the fact that they can only be studied by a small number of pupils at a time. These are practical difficulties in the use of such picture sets as an aid to the teaching of geography. Considerable experience shows that these difficulties too often result in valuable material being relegated to the store cupboard.

MEETINGS: SESSION 1942–43

Fourteenth Meeting, 8 March 1943. The President in the Chair

Paper: Javanese Colonization of Sumatra. By Mijnheer Wibo Peekema, Royal Netherlands Government

Fifteenth Meeting, 15 March 1943. The President in the Chair

Elections: N. Dewhurst; Edward Harpur Fryer; Walter Wilfred Edwa Giles, B.A.; Lieut. Ian Richardson Hamilton, M.A.; Richard Edes Harrison; Percy A. Leon; Walter E. Newman; William H. Dent Robinson, B.A.; Lieut. S. E. Sharpe, D.S.C., R.N.V.R.; 2/Lieut. Percy Charles Sherwood, R.E.; Leslie J. Thompson; Percival Clarence Waite

Paper: Norway's war effort. By Admiral Sir Edward Evans

Sixteenth Meeting, 22 March 1943. The President in the Chair

Geographical Films: Burmese scenes. Kodachrome films by Lady Cochrane. Commentary by Mr. Myat Tun